CRANFIELD UNIVERSITY

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DEVELOPMENT OF A LEAN PRINCIPLES FRAMEWORK FOR ERP IMPLEMENTATION PROCESS

SCHOOL OF AEROSPACE, TRANSPORT AND MANUFACTURING

PhD
Academic Year: 2018

Supervisor: Professor Essam Shehab
Associate Supervisor: Dr. Ahmed Al-Ashaab

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ABSTRACT

The aim of this research is to develop a novel framework based on lean principles and tools to be exploited in managing ERP implementation processes in order to enhance the overall success rate of the implementation project, which in turn minimises cost and time overruns. The framework consists of three stages built in a logical sequence taking into consideration the requirements of ERP projects implementations and the lean transformation principles.

The first stage starts with an assessment model to measure the organisational readiness for implementing ERP system using leanness assessment approach. The second stage of the framework introduces the use of the Obeya lean tool along with a change management model to help visualize and streamlining the process of ERP implementation. In the final stage, a value stream mapping technique is used to identify potential waste occurrence and eliminate non-value adding activities from the process. As a result, a new eight stages ERP implementation process is developed and presented with descriptions on the activities encompassed in each stage.

A research methodology consisting of four major phases was employed to attain the targeted objectives of the research; beginning with project initiation and contextual definition followed by data collection and field study. The data acquired from the previous two phases were used to conduct a thorough analysis from which key findings were drawn and used in the creative development of the readiness assessment model and the framework. Finally, elementary aspects of the framework were put to scrutiny through live case studies and professional expert judgement. The author made use of both qualitative and quantitative research measures.

A validation for the ERP readiness assessment model is conducted initially on three case studies, and then the whole framework is validated through two other case studies and experts' judgments. The results and overall feedback reflected a high level of acceptance of the framework structure and approach. The novel framework has the capability to improve the ERP implementation process

providing it is utilised fully. It helps organisation to successfully deliver ERP systems on time, on budget, and with the required functionalities with high-level of acceptance from all stakeholders.

Keywords: ERP Implementation, ERP Readiness, Lean, Lean IT, Leanness Assessment.

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Finally, I gratefully dedicate this thesis to the memory of my father, [Qurban Abdullah], who always believed in my ability to succeed, who taught me through his actions more than his words, who has been and always will be my role model, and whom I still miss every day.

LIST OF PUBLICATION

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LIST OF ABBREVIATIONS

ACM	Association for Computing Machinery
BPR	Business Process Reengineering
BSI	British Standards Institution
CRM	Customer Relationship Management
CSD	Customer Specification Document
CSF	Critical Success Factor
CSI	Continual Service Improvement
DSD	Digital Service Department
DT	Digital Transformation
DTP	Digital transformation programme
ERP	Enterprise Resource Planning
FAQ	Frequently asked question
GDPM	Goal directed project management
GDS	Government Digital Service
ICT	Information Communication and Technology
IM&T	Information Management and technology
IMVP	International Motor Vehicle Program
IOA	Implementation and optimal adaptation
ISO	International Organisation for Standardisation
ITIL	Information Technology Infrastructure Library
JIT	Just in time
KI-VP	Knowledge Innovation / Visual Planning
KPI	key performance index
KSS	Kanban-based Scheduling System
LDR	Local Digital Roadmap
LM	Lean management
MIT	Massachusetts Institute of Technology

MRP	Material Requirements Planning
NHS	National Health Services
NPfIT	National Programme for IT
OGC	Office of Government Commerce
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMP	Project management professionals
PPM	Project phase model
PRINCE2	Projects IN Controlled Environments
S-ERP	Sustainable ERP
SCM	Supply Chain Management
SD	Service Design
SME	Small to Medium Enterprise
SO	Service Operation
SS	Service Strategy
ST	Service Transition
STC	Saudi Telecom Company
TMS	Top management support
TPS	Toyota Production System
VCB	Visual control boards
VSM	Value stream mapping

Chapter 1

INTRODUCTION

1.1 Research Background

The current digital transformation era and the continuous elevations in global competitiveness and socio-technical advancements has forced businesses to populate the required capabilities to address the market needs in order to sustain business and generate revenue (Leipzig et al., 2017). Automation of business processes became an essential requirement in all businesses and government organisations and it is becoming a vital element for success with the mounting digital transformation programs taking place around the globe. Conserving quality, sustaining competitiveness, reduction in time to market and minimising cost are considered essential objectives that must be addressed to face the challenges of the business environment (Zouaghi and Laghouag, 2012). Through innovation and adaptation of enterprise strategies, businesses have started to experience substantial improvements (Bilgeri, Wortmann and Fleisch, 2017), amongst these include the utilisation of automation of business processes as a response to the increasing demand for e-business solutions. Enterprise Resource Planning (ERP) system is one of the essential enablers for e-business and digital transformation initiatives.

In the early sixties, Material Requirements Planning (MRP) systems were developed in the manufacturing industry with limited functionalities, the evolution was transpired to the entire enterprise and as a result, Enterprise Resource Planning (ERP) emerged. In comparison to the MRP, the ERP system takes into consideration, categorically all aspects of the business as well as encapsulating the manufacturing aspects. The coverage of the ERP systems includes: materials, capacity planning, scheduling, shop floor control, finance, Human Resource (HR), customer satisfaction and supplier relations. As (Simon, 2011) attests, ERP has become one of the most popular business management

systems that is being utilised across numerous industries as its primary automation system.

Through corrective measures, ERP systems have helped businesses gain copious benefits which include instantaneous results and the enhancement of organisational communication (Shehab et al., 2004). As a strategic tool, ERP helps through its integrative modules, all business processes as well as optimisation of available resources (Zouaghi and Laghouag, 2012). Notwithstanding their benefits, the complexity of ERP systems cannot be dismissed, and the nature of implementation of such systems is challenging, time-consuming and financially demanding which place an incredible burden on corporate time and resources.

The dynamic nature of today's IT landscape, through its introduction and release of new technologies poses challenges in the selection of the correct technological solutions that are in conformance to the business needs. In such instances, the implementation of ERP becomes a predicament for every CIO whose decisions dictates and impacts the notion of business competitiveness and success. The intensification of the challenges increases if the ERP implementation is to be undertaken on a multi-national, multi-site organisation. Additionally, other key challenges typically encountered by such organisations include (but not restricted to): the multitude of departments covered across different locations, dissimilar IT systems adopted for various processes, and non-standardisation of processes (Muscatello and Parente, 2006).

Despite the high number of ERP implementations conducted throughout history, relatively a low number of these could be considered successful. An industrial study revealed 75% of the projects did not finish on the original planned time and 55% exceeded the budgeted coast (Panorama Consulting Solutions, 2015). Typically, ERP implementations encounter delays on estimated schedule, overruns on the initial budge or have shortcomings in their initially planned functionalities (Ehie & Madsen, 2005; de Bakker et al. 2012).

Lean is a term that is associated with the enhancement of value and its systematic decomposition and elimination of waste. The Lean principles

proposed by Womack based on the Toyota Production System (TPS) to improve the productivity of the shop floor by eliminating waste is described as: specify value, identify the value stream and eliminate waste, make the value flow, let the customer pull the (value) process, and pursue perfection (Womack, Jones and Roos, 2008). These principles have been applied in the shop floor what is commonly referred to Lean Manufacturing.

After the exceptional success of Toyota through their TPS, the concept of lean philosophy started to become more concomitant with the manufacturing industry. Whilst maintaining the lean philosophy other industries such as Education, Healthcare, Construction, and IT have started to utilise the lean principles to their advantage (Proudlove, Moxham and Boaden, 2008; Riezebos, Klingenberg and Hicks, 2009; Souza, 2009). In principle, lean could be used with any process to turn the separately managed activities into an end-to-end value stream and as a means for continuously managing the process for further improvements.

The lean software development concept initiated in the early 2000s, it forms its basis on the application of the well established lean principles into an effective management approach to software development as explained by Popperndieck & Poppendieck (2003). Having successfully implemented the principles of lean to great extent in managing complex management transformation, the complexities with ERP implementation deemed a big challenge for those organisations. A research by Haley (2014) revealed that applying lean principles to information technology (IT) projects result in schedule reduction. Haley (2014) analysed archived secondary data, for IT projects in the defence industry, using non-experimental quantitative methods. And they noticed that it is challenging to apply lean in variable environments such as IT implementation projects.

Both the implementation of ERP systems and lean transformation initiatives in any organisation create major change that requires good change management practices to obtain efficacious results. Organisational change management and transformation initiatives enforce massive challenges to existing business

landscapes and leading such change is very perplexing and full of complex obstacles.

The research presented in this thesis studied the application of lean principles on ERP implementation processes and aimed to develop a novel framework to aid this transition. Conventionally, the ERP implementation process is managed using typical project management approaches, however through the incorporation of lean principles with its process improvement process approach it is expected to complement, enhance and further strengthen the effectiveness of project management. A single lean tool cannot solve all the predicaments; therefore, the research investigates the applicability and suitability of the required lean tools/techniques to solve the expected occurrences of the problems during the implementation process, which will be housed in a framework to ensure their corrective selection.

1.2 Research Motivation

The ERP software market is growing rapidly; it was around US$ 22 billion in 2008 ((Shehab, Thomassin and Badawy, 2011) and (IGate, 2018) forecast the enterprise software market to exceed US$ 575 billion by 2024. The total implementation cost for an ERP system for a Small to Medium Enterprise (SME) can reach tens of Millions of dollars, and in large corporations the range is US$ 300-500 million as highlighted by (Mabert, Soni and Venkataramanan, 2003). Allied Waste Industries terminated the ERP implementation project after it cost them US$ 130 Million (MOMOH, 2015). Even though there is a long history of ERP systems and numerous implementations that have been undertaken during the course of years, the failure rate is still as high as 50% of all ERP implementations, the reasons for which vary from case to case (Muscatello & Parente, 2006). According to (Al-Turki, 2011) 68% of ERP implementation projects could be classified as partially failed and 7% as total failure. Moreover, an in-depth investigation and studies of cases by Standish Group reported that: on average 30% achieved the required functionality, 70% were over budget and the time overrun exceeded 2.5 of the expected time (Momoh et al. 2010).

Decisions of ERP system selection are driven mostly by the ERP software costs; however, the cost constitutes only 15% of the total cost of implementation. This under estimation of cost leads to cost overruns as well as contributing to the overall failure of the projects (Ehie & Madsen, 2005; Momoh 2015).

The ERP implementation process is strenuous on time, the complexity of complications range from multiple variables which covering different types of organisational functionalities (Iba, 2006). It is compulsory that all ERP users and participants strive to adhere to techniques and identify solutions in order to increase the success rate for the implementation whilst managing the cost and effort at its source.

Recently, organisations have started to adopt lean thinking in order to further enhance their business attainment, this has been briefly discussed in the previous section and a more detailed account is presented in the proceeding Chapter under Section 3. It is necessary to mention that, Lean IT is relatively a new approach to help organisations advance towards high performance. Taking into consideration the critical success factors for ERP implementation whilst acknowledging the high failure rates there is an opportunity to incorporate lean type thinking through the use of lean principles and its tools/techniques to form a lean based framework for successful ERP implementation to address and resolve the predicaments as well as increasing its overall success rate in an effective manner.

1.3 Research Scope

The scope of the research entails the successful development of a lean based framework, which utilises the most applicable lean tools and principles to enhance the ERP implementation process. Hypothetically, as a consequence of this, the overall success rate of the implementation will be increased. In order to marginalise the research, the following areas have been covered: (1) taking into consideration the complete process from a feasibility perspective through project planning; (2) rollout to post implementation and maintenance stages of the process and (3) placing careful attention on the most critical

success factors associated with the implementation. In order to substantiate the validity, applicability and coverage of the research, the author will conduct case studies of large government and independent corporations in Saudi Arabia. Furthermore, the case studies will be used retrospectively with the developed framework to capture a critical and analytical review and validation from experts.

1.4 Research Aim and Objectives

The aim of this research is to develop a novel framework based on lean principles and tools to be employed during the ERP implementation process in order to enhance the success rate of implementations which in turn reduces lead-time and cost.

The primary objectives of the research are to:

1. Explore and analyse the current ERP implementation processes as well as capturing the critical success factors for its implementation in order to identify and classify opportunities for improvement;
2. Map the current practices of the ERP implementation processes against the lean principles which will serve as the technical platform in the development of the lean assessment mechanism;
3. Assess the ERP implementation process using the value stream mapping technique to identify the possible waste occurrence and the suitable lean tools that could be employed for waste elimination;
4. Develop a lean based framework for ERP implementation process and its associated tools;
5. Validate the proposed framework through case studies and experts' opinion.

1.5 Thesis Structure and Summary

This section delineates the structure of the thesis and a description of the activities conducted in order to realise the research aim has been presented in Figure (1-1)..

The opening Chapter of the thesis provides a brief synopsis of the research by discussing its background and the motivation behind the investigation. In order to contain and keep a focalised study the research scope, aims and objectives have also been listed followed by a listing of the deliverables. Chapter 2 provides a detailed account of the scientific literature which has been reviewed. The purpose of this review is to capture the current trends in the discussion as well as identify research gaps. The research methodology adopted by the author has been detailed in Chapter 3, the research approaches and strategies have been explained and the selection of data collection methods has been justified.

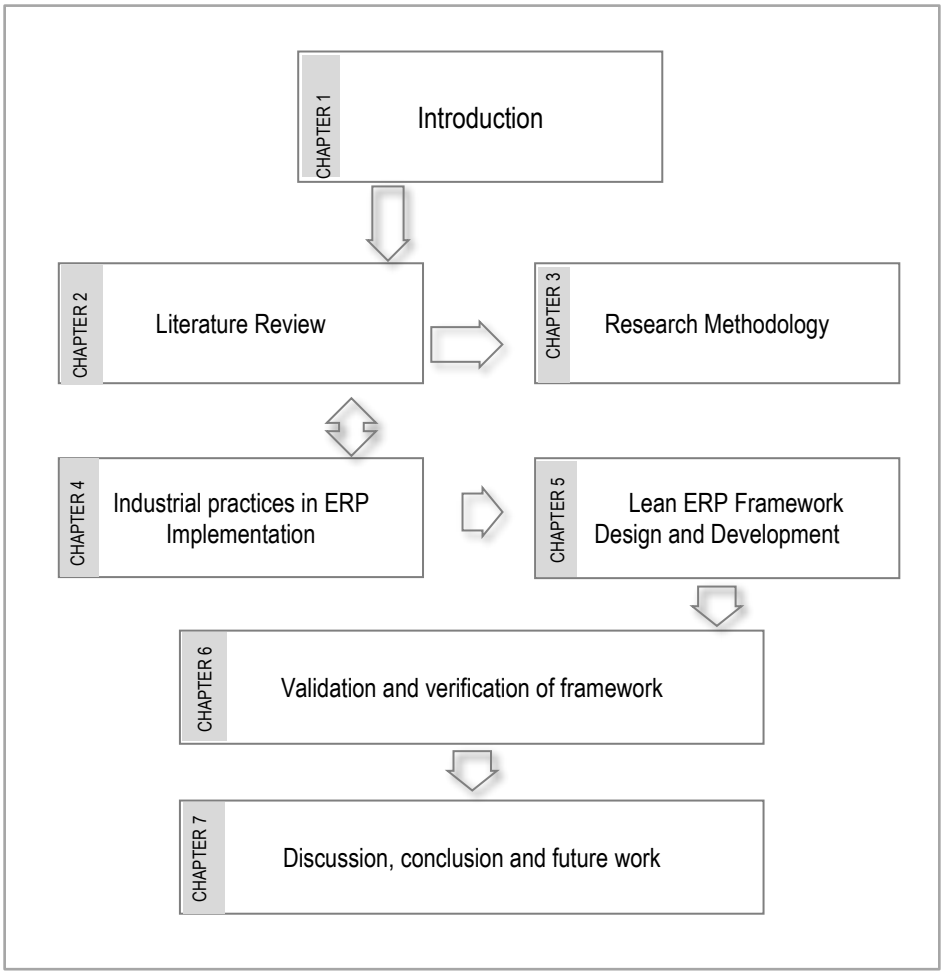


Figure 1-1 Thesis Structure

Chapter 4 provides a discussion of the field of study and its results. The purpose of this study sought to establish the current awareness amongst practitioners regarding lean principles and tools during the ERP implementation process. The findings of the survey are graphically illustrated followed by a thorough analysis of the findings.

In Chapter 5, the developed lean based framework for ERP implementation is introduced with description for its different constituents. The process phases, stages, and activities to be performed throughout the process to ensure successful implementation are covered. The author provides technical discussions and arguments for the selection and arrangement of the activities. A high level guideline for some of the activities has been developed; comprising instructions of using the framework along with the required forms and techniques.

Moreover, the chapter comprises a through dissection and explanation of the first part of the framework; the leanness assessment model which cover the model design methodology, a description of its constituents, and its five enablers. The chapter also presents the industrial testing of the for the model with three case studies and the findings in order to establish correlations; the case studies results are presented and discussed farther. The last sections of the chapter explain the remaining parts of the framework, which covers two modules; change management and Obeya room. The elected change model is discussed with some guidelines on how to apply the model in ERP project. Then, the Obeya room is introduced by exploring its background and benefits followed by application guidelines for the room in ERP context. The chapter ceases with the enlightenment for the construction and development of the ERP implementation process.

The validation and verification of the full framework are put forth in Chapter 6, each case study is detailed; drawing references to the suggestions, complications and the overall success encountered during this stage of the

research. In addition t the case study validation, the chapter presents the result of the validation provided by industry experts.

The thesis ceases with Chapter 7 that synthesise outcome of the research. The contributions the study has made to knowledge are listed; the limitations and possible areas for future research are also highlighted. The thesis ceases by drawing conclusions and how well the research aim and objectives were achieved.

The proceeding chapter provides a detailed review of scientific literature in the following areas: ERP implementation, critical success factors, adopting lean type thinking to ERP implementation and change management

Chapter 2

LITERATURE REVIEW OF LEAN ERP IMPLEMENTATION

2.1 Introduction

The aim of the research is to develop a framework based on lean thinking to manage ERP implementations. The primary objectives reported in this thesis are the exploration and critical analysis of current ERP implementation processes and the effective capture of critical success factors for its consequent implementation, which will in turn be used to identify and classify opportunities for improvement. It is in the interest of this research to conduct a literature review to identify the current status of scientific discussion regarding ERP implementation and to identify the prospects of adopting lean principles to manage and further enhance the implementation process. This discussion will serve as the essential 'know how' platform, which will be used as a key element in the development of the framework as listed in Chapter 1.

The main objectives of the chapter are to identify the research gaps through the understanding of available research in the area of ERP implementation and lean management. There are three main parts that constructed this chapter; the first part is covering ERP system and its implementation. The second part is dedicated to investigating the concept of lean and its implementation in non-manufacturing industry. And the final part of the chapter presents the research gap and its analysis.

This chapter addresses this concern through an extensive scientific review of literature; the key areas of investigation have been depicted in Figure 2-1. Having introduced the Chapter in Section 2.1, the key areas of investigation

have been organised based on the logical orientation of the research inquiry, for example Section 2.2 has been allocated for the topic of ERP system overview, while section 2.3 explore the ERP implementation, and section 2.4 present ERP Readiness. Additional areas that are considered essential but supplementary to the research such as project management and change management have been presented in Section 2.5 and 2.6 respectively, followed by a review of on Lean thinking literature in Section 2.7. The key research gaps are drawn and listed in Section 2.8 followed by a Chapter summary in Section 2.9.

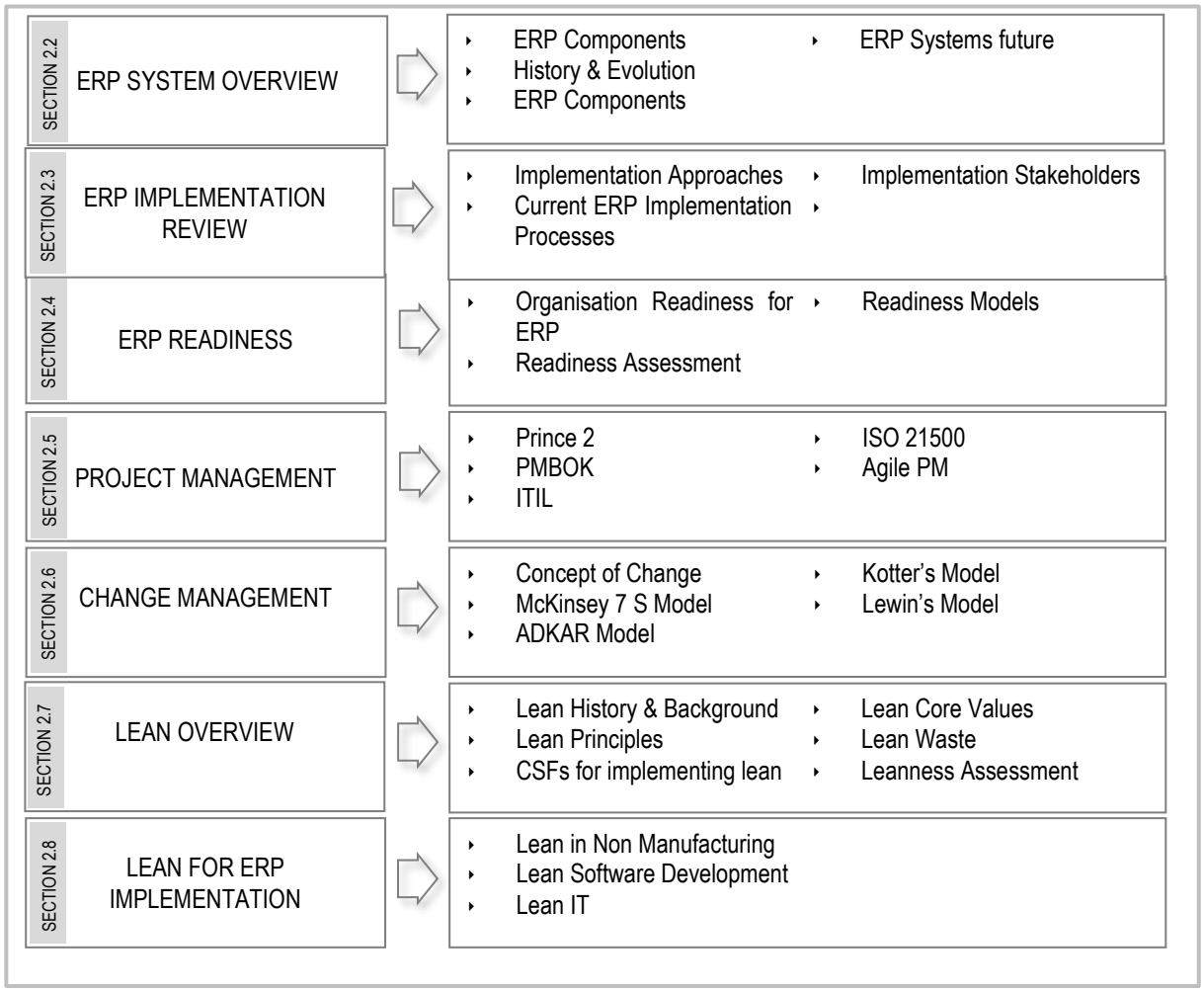


Figure 2-1 Key topics of investigation in the literature review

2.2 Overview of ERP Systems

The purpose of this section is to review the relevant information associated with ERP systems and implementation approaches and the critical success factors. The section ends with illustrations of the different implementation processes.

2.2.1 ERP History and Evolution

In the early sixties, Material Requirements Planning (MRP) system was developed in the manufacturing industry to aid in the management of materials in terms of quantification based on requirements (for organisational and scheduling tool only) (Wallace and Kremzar 2001). MRP II was the second generation and came with more functionality such as distribution management, shop floor, project management, finance, and human resource (Rashid, Hossain et al. 2002). In the 1980's, MRP II was implemented and working in tens of thousands of manufacturing firms (Guamer 1996).

Enterprise Resource Planning (ERP) evolved from MRP II and extended beyond the traditional boundaries of manufacturing processes to incorporate all the stakeholders with emphasis on the customer and suppliers. ERP systems incorporate all functionally active areas business which covers materials and capacity planning, scheduling, shop floor control, profitability, customer satisfaction and supplier's relations – practically every aspect of the business (Wallace and Kremzar 2001). The development of ERP systems evolved into a modular structure that enabled the incremental implementation of the system and reduced risks (Cooper 2008).

As a result of incorporating ERP systems, operational efficiency and aptitude of the business are greatly improved inevitably. ERP systems are powerful IT solutions that are promising that enables organisations to function more effectively whilst ensuring the productivity is greatly improved, providing the systems is fully utilised in its correct order.

The 1990s witness a rapid emergence and growth of technology, ERP system was not short of this and was one of the leading areas of development which

provided businesses process integration throughout the functional area. New developments and the number of options in both software and hardware quickly grew; especially with the Y2K threat that drove organisations and major software vendors to seek out upgrades to counteract this warning. Throughout the history, the ERP market has witnessed the incline and decline of many vendors; currently, the key players are SAP, Oracle and Microsoft. Second tier vendors include Infor, Epicor, and Sage. The next phase of ERP systems sets out to merge products and move to full cloud computing to enable artificial intelligence applications.

ERP systems became a web-based ERP solution after the spread of the Internet by the year 2000 (Lawton, 2000). This development entailed the necessity for integration between ERP system and other business applications such as project management systems and other operating systems. ERP system became the backbone for many e-business solutions, which led to high customer satisfaction and operational excellence. Furthermore, the development and advancement of ERP systems have seen an incremental increase in more technical functionalities through the integration of additional applications such as Supply Chain Management (SCM), Customer Relationship Management (CRM) and E-Procurement (Wu, 2011). ERP systems have started to gain popularity and multiple industries and government departments have taken notice of this and started to utilise and reap the benefits from it. E-commerce implementation and the business-to-business (B2B) systems were enabled by ERP system and gained faster access. As a consequence, ERP system moved from being a back office system to a front office, because of the interface with all customer-facing systems. The estimated size of the ERP market, in 2008, was 34.4 billion USD in software licenses and 103 billion USD in ERP related services (AMR Research, 2008)

2.2.2 ERP Components

ERP systems are composed of major components which are technically termed as modules, each module consisting of sub-modules that facilitate the integration and management of components that are associated with the

different department of the organisation. There is, however, a set of common modules amongst the different types of available ERP systems they generally include a database and management portal, **Error! Reference source not found.** reflects typical ERP system components (Davenport, 1998).

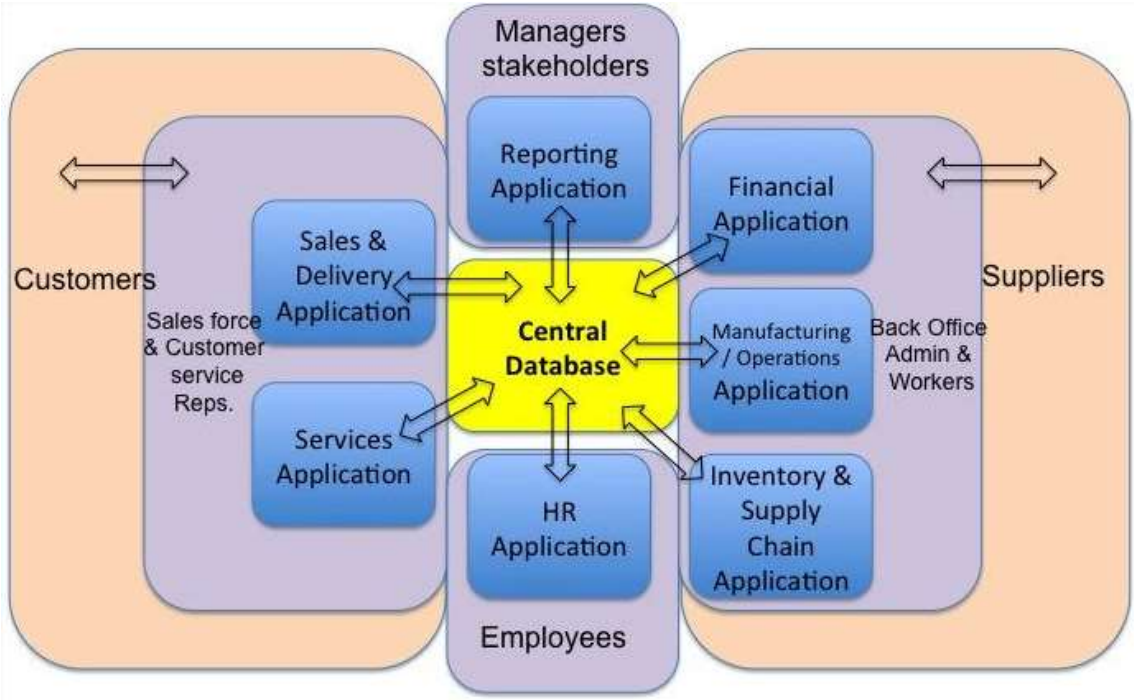


Figure 2-2: General ERP Components (Davenport, 1998)

2.2.3 ERP Critical Success Factors

A great deal of research has been undertaken to investigate and study the Critical Success Factors (CSFs) of ERP Implementations. Namely, some of the most comprehensive review articles published on the topic CSFs in the field of ERP implementation include Nah et al. (2001), Somers & Nelson (2001), Finney and Corbett (2007), Dezdar & Sulaiman (2009), and Momoh et al. (2010). Despite the high number of articles discussing CSFs, Dawson & Owens (2008) argued that critical success factors are not similar in all articles, the underlining reason for this is the different use of terminology, which directly to refers to the same CSF, and in some cases, authors combine two CSFs into one CSF.

Taking the aforementioned into account, for the purpose of this research, the CSFs covered in Momoh et al. (2010) will be used a standardised margin, the reason for this decision is that the work by Momoh et al. was comprehensive in nature and in its detailing which included citations from 1997-2009. Table 2-1 lists the nine critical success factors of Momoh et al. (2010) ranked from the most cited factor to the least

Zhe Zhang et al. cite business process re-engineering as a critical factor to the success of the implementation project. They argue that one of the principal reasons of ERP implementation failure is that organizations simply under estimate the extent to which they should change and re-engineer the existing business processes to accommodate their purchase. Shanks's PPM includes a sub-phase that has an additional component of business process re-engineering.

Table 2-1: List of Critical Success Factors (Momoh et al. 2010)

Rank	Critical Success Factor	Descriptions
1	Lack of change management	Not to be treated as a software installation effort only. Should be a program that includes: technology, task, people, structure, and culture.
2	Excessive customization	An optimal strategy is to balance between customization of ERP system and changing the organizational procedure within the company.
3	Dilemma of internal integration	To have end-to-end processes with the managed costs, risks, and changes involved.
4	Poor understanding of business implications and requirements	Realize the full benefits of the solution and reconcile the technological imperatives of ERP with the business needs.
5	Poor data quality	To avoid data format incompatibilities with ERP package.
6	Lack of top management support	It is essential to the success of large and complex projects.
7	Limited training	Importance of training of all concerned staff with the right timing.
8	Misalignment of IT with business	To have a dynamic process of mutual adaptation between IT and the rapidly changing business environment.
9	Hidden costs	Need to cover all aspects such as integration, data conversion, and consulting cost.

2.3 ERP Project Implementation Review

2.3.1 ERP Implementation Approaches

There are two main approaches to implement ERP systems in an organisation; one of the approaches to implementing a new ERP system is the full installation of the system across the organisation in a single stroke. This approach was commonly witnessed in the mid-90s due to the issues concerning the Y2K compliance. One of the major advantages of this approach is the short implementation time and consequently the minimal cost associated with it. However, there is a high risk of failure associated with this approach because of the 'everything-at-once' nature of the approach (Mabert et al. 2003). The one-time implementation is easier to manage on a single site than multiple sites. One of the major challenges of this approach is full system testing which is hard to achieve; full functionalities and integration are only possible when the system goes live.

The second approach is the franchising strategy of implementation of a partial integration across a few divisions (Lau, 2003), this is also known as Key-Process or Unit-by-Unit implementation, and this is the approach in which the ERP system rolls out in stages. With this type of implementation, the most important ERP modules to an organisation will be initially installed followed a continual step-wise progression onwards. HR and finance functions are usually the commons across the organisation, followed by specific departmental functions.

This is a common approach among large or diverse organisations where top management seeks out a branch or a department with an open-minded team for a pilot implementation in their specific area of work. Following the piloting of the implementation phase, the implementation team could be utilised in providing first-hand support and guidance to implementation teams in the continual phases. This approach is considered to be time-consuming but staff resistance is considered low due to the constant feedback and discussion among colleagues.

This approach has its own advantages; gradual implementation leads to fewer disruptions in the organisation. The inaugurating (open-minded) team leads to a better learning curve and reduces anticipated risks. On the contrary, one drawback of this approach is that it requires high investment for the implementation.

Usually it is recommended to implement one ERP system in the entire organisation; however, not all organisations go by this rule. Ideally, the acquisition of an ERP system for the core function to build upon building other stand-alone systems in order to establish an interface between the systems results in a high-performance system. An organisation could select a single vendor package for its ERP system or it can choose to have different modules from different vendors and integrate them into its systems (Shehab et al. 2004).

In conclusion, each approach has its own advantages and disadvantages, and it is important that organisations select the most appropriate implementation strategy that is in compliance with their needs and requirements. In all cases, a number of factors needed to be considered before deciding on which implementation approach to adopt, these include regulatory compliance, acquisitions, capital expenditure programs, an acceptable level of risk and new product introductions. Undoubtedly, ERP implementations are complex due to their scale, scope, and Business Process Reengineering (BPR) requirements.

2.3.2 Stakeholders in ERP Lifecycle

Stakeholder management is looked at as one of the core principles of project management, and an important significant capability within projects is the understanding the influences of stakeholders and their developing engagement (Morris, 2013; PMI, 2013). Aaltonen & Kujala (2016) concluded that the stakeholders are “all organizations and individuals that can affect or are affected by a project and of relationships among these organizations and individuals”. Recognising its importance, PMI included stakeholder management as a new best practice knowledge area in the Project Management Body of Knowledge (PMBOK) in 2013. The Stakeholder theory is based on contemplating and balancing the relevant interests of all possible stakeholders in order to create

and sustain their support (Freeman, 1984; Jones and Wicks, 1999), and it is vital for stakeholders to engage in the project at the very early stages (Greenwood, 2007).

Regardless of the project's nature, one of the strong reasons for project failure is the lack of practical and efficient interactions between the project stakeholders (Achterkamp and Vos, 2008).

The nature of ERP implementation is technically complex and has an impact on almost every department and function in the organisation as well as other external parties. Hence, this affects the interests of the different stakeholders during the various stages of the project (Kamal et al 2011) and could lead to conflicting views from the different players. Some of the stakeholders in ERP implementation project identified by (Boonstra, 2006) are Top Management, IT department staff, ERP Project team, End users, and External Consultancy. Andersson and Olandersson (2013) investigated the relationship between ERP vendors and the consultants and their role within the stakeholders' landscape. Many of the challenges in ERP implementations stem from its stakeholders, thus, it is vital to identify those major players and understand their expected reactions to be able to neutralise their influences (Bhasi et al 2014). Alsulami et al, (2016) identified a new critical success factor as 'stakeholder conflict management' and they presented four types of conflicts that occur among stakeholders. Previous literature has identified stakeholders' impact as one of the critical success factors in ERP implementations.

After reviewing the literature, it is concluded that the most influencing / significant stakeholders in ERP implementation project are: Top Management, Consultancy Firms and Consultants, ERP implementation PMs and End users. The following sections will provide some insights on each stakeholder and their importance as discussed in previous literature.

a) Top Management:

Top management is defined as the highest management level in the institution such as the CEO or managing directors who are usually responsible for setting corporate strategy and policy Boonstra (2012).

Most of the major projects in organisations are associated with enormous change, and for these projects to be successful a strong and effective top management support (TMS) is required. ERP implementation is one of these projects and the previous literature has extensively addressed the importance of TMS. Almost all the literature on the critical success factor of ERP implementation included TMS as one the primary factors (Bansal & Agarwal 2015, Boonstra (2012), Elbanna 2011, Martin & Ziaul Huq 2007, Dong, (2001). Young & Jordan 2008 argues that TMS is not one of the CSFs only rather it is the most important CSF.

Bansal & Agarwal 2015, studied the relationship between TMS and the level of competence of the project team and found out that with more support from top management the project team become more competent. And Sudevan et al (2014) analysed the role of top management during the different phases of ERP implementation, they also identified the importance and level of required involvement in each of the four stages off initiation, adoption, adaptation, and use. Barsukova (2013) presented how consultancies perceive top management role and the preferred level of commitment consultants look for. Furthermore, Boonstra (2012) discussed the types of behaviour that are associated with top management support which are: Accommodating the implementation project, reshaping organizational context, adapting the information system to the organization, and Dealing with other stakeholders. Furthermore, they presented the reasons for top management to withhold their support at some stages of ERP lifecycle. Elbanna (2013) scrutinized the top management support in a multiple-project multiple-site environment and looked at relationship complexity. The author revealed that in such environment, the support of top management fluctuates over the project lifecycle because of their support shifts from project to another.

Additionally, Young & Jordan 2008 argued that TPS is more a comprehensive factor that comprises other CSFs, and their findings negate previous conventional thoughts. They also recommended that advice provided to top management should be of a direct interest to them such as the expected value from the ERP system, and to avoid advice that aim to improve technical quality. Martin & Ziaul Huq 2007 argued that, during ERP implementation, top management should concentrate on cultural and environmental aspects only such as managing employee behaviour. This is because top management has the proficiencies and power that enable them to influence these factors. Dong, (2001) analysed the top management commitment to change management and to resources, they also discussed top management's role under five types of implementation modes.

(Olivier et al., 2009) reported that optimization of top management role is an indispensable condition for project success. They presented several actions that should be taken to improve TMS in ERP implementation projects

b) Consultancy Firms and Consultants

Generally, organizations employ external ERP consultants to overcome the implementation complications, and they are considered as a major stakeholder Alsulami et al, (2016). External consultants have accumulated knowledge and experience from the diverse real-life ERP implementations they were involved in. They play a very important and prominent role in the implementations of ERP systems and contribute in steering the project to success by helping organisations overcome their difficulties Lapiedra et al. (2011). External consultants deliver business and technical expertise and help in training end users (Momoh 2015). The terms “Consulting Firms” and “Consultants” will be used interchangeably in this research.

The ERP literature explored the external consultants’ contents from different perspectives such as their roles, their associated cost, and their relations with other stakeholders. Momoh (2015) discussed the importance of the cost of consulting in ERP projects and how it is underestimated most of the times and result in the budget overrun. Kumar et al (2002) stated that in one of the ERP

implementation projects the cost of consulting reached as high as 70% of the total project costs.

Coelho et al. (2015) investigated the relationship between the consultant and the client in ERP implementation project. They listed three types of client-consultant relationship namely dependency, autonomy, and cooperation and they explored the dynamic power and knowledge of each type. Andersson and Olandersson (2013) analysed the relationship between the consultant and the ERP vendor and presented of the impact of the relationship type on the role of consultants. They presented the differences between a vendor in-house consultant and the independent consulting firm hired directly by the client.

Barsukova (2013) explore the consultants' viewpoint of ERP implementation process and their interaction with the client. The study presented the shared attitudes of consultants such as the need for quick and effective decisions making by clients, the presence of competent and devoted staff in the project team, and to avoid system customizations.

Lapiedra et al. (2011) conducted a study on the effect of consultant quality on ERP implementation success. They provided empirical evidence that ERP implementation success is highly affected by the quality of the external consultant. And they argue that a high level of organizational learning capability end-user satisfaction could be achieved easily. Finally, Jamie et al (2011) discussed the application of control mechanisms for coordinating the work of the different ERP consultants. They argue that effective coordination leads to successful implementation of the different modules of the ERP system.

c) ERP Implementation PMs

Project Managers (PM) are normally responsible for organizing the ERP implementation project for success. They identify the details of every task, assign it to the correct person, and ensure that all tasks are completed on-budget, on-time and exactly as planned. PM should be fully supported by the enterprise's top management and should be empowered to direct the actions of each individual participant in the implementation project (Sudevan et al., 2014).

PMs can hinder the success of the project by allowing other stakeholders to resist or confront the project. To overcome this potential weakness, PMs should have the ability to report to high-level managers that have the privilege and power to enforce positive actions in favour of project's interests (Sudevan et al., 2014). The resistance of end users is one of the most common hindrances faced by PMs and is usually due to changes in the business process that is perceived as negatively impacting end users' workflow. Therefore, PMs should be committed to the project until the final stage to engage end users with clear communication channels.

d) End users

As mentioned earlier, end users are likely to resist the ERP implementation project given the changes imposed by the project to business processes. Therefore, it is necessary to comprehensively evaluate the impact of the project on end users. A complex or demanding ERP software could cause end users to fail to adapt to it unless precautions are taken (Kwak et al., 2012). It is important to understand that system users need are concentrated on completing business processes efficiently and easily track uncompleted processes. End users involvement is not less important than executives and managers involvement in the implementation project to succeed (Sudevan et al., 2014).

2.3.3 Project Management methodologies

Project management is a discipline used with all types of projects such as construction, sales, and information technology (IT). Because of the specific provisions and requirements, all major bodies for project management standard has specific editions for these types of projects including ERP implementation projects. It deems essential to explore some of the most elect project management methodologies that are favoured by industrial practitioners, these findings will be considered in developing the intended lean based framework.

2.3.3.1 PRINCE 2

PRINCE2 (Projects IN Controlled Environments) is currently the most popular project management methodology used in Europe. PRINCE2 methodology is widely favoured because of its nature, which is step-by-step, or 'how-to' type of reference.

One of the advantages of the PRINCE2 approach is its flexibility. Easily adapting to the needs of an organisation, it can work alongside other management models.

2.3.3.2 PMBOOK

Currently, on its fifth edition (published in 2013), the Project Management Institute (PMI) originally formulated the Project Management Body Of Knowledge (PBMOK) in 1987 to standardise project management approaches for consultants and practitioners alike (Matos & Lopes, 2013). Its aim was to both provide a common language for project management professionals (PMPs) with which to improve communication, as well as educate all those involved in the success of a project on the range of measurable deliverables they should be seeking to provide.

The PMBOK's methodology like many other project management systems uses a process-based approach to manage the efficacy of a project's outputs.

The guide's comprehensive nature should allow for it to be applied to an IT framework with ease. While the needs, risks and requirements of an organisation may have been identified and planning carried out; IT projects have a considerably low success rate of 16% (Ghosh et al. 2012).

2.3.3.3 ISO 21500

With the support of the ISO (International Organisation for Standardisation) in 2007, hundreds of PMPs and numerous committees from over 30 countries embarked on a five-year project resulting in the ISO 21500 (Stellingwerf et al. 2013).

An international team was perfectly suited to follow the ethos of the ISO who since 1947 have quested to create globally recognised professional standards across numerous industries. Overlapping with some 95% of PMI's PMBOK methodology, the ISO draws attention to what is involved in project management without offering definitive instructions on how to execute each step (Stellingwerf et al. 2013).

For newcomers to PM, the guide's abundance of knowledge coupled with its easy to follow terminology will bind them to fellow practitioners. While the debate continues to rage, Ibbs & Kwak (2000), Zwikael & Globerson (2006) continue to subscribe to the belief that the success of a project management approach can be affected by its industry (Zwikael, 2009).

2.3.3.4 ITIL

The Information Technology Infrastructure Library (ITIL) was established in the early 1980s in response to the British Government's desire for a framework to ensure the consistency and quality of IT service being delivered (Wickboldt et al., 2011).

The ITIL promises organisation that make use of their model, reduced costs as wasteful practices are eliminated and increased customer satisfaction and overall productivity (Hui, 2012).

The ITILs' coherent approach is structured around a service cycle whose flow includes and titles each of the publication that make up the third version of the framework: Service Strategy (SS), Service Design (SD), Service Transition (ST), Service Operation (SO), and Continual Service Improvement (CSI) (Abid, 2012).

The importance of ITIL's methodology is that it addresses legal requirements so as to ensure compliance as well as meet stakeholder and customer "round-the-clock service expectations while providing support for business agility, cost reduction and innovation" (Hurwitz & Demacopoulos, 2009).

2.3.3.5 Agile project management

Agile project management is a relatively recent approach that has started in the software development field as an alternative to traditional methodologies that proved inappropriate and potentially disadvantageous for complex projects that are limited in time with the considerable level of uncertainty, a common situation for software development projects. The Agile Manifesto (Fowler and Highsmith, 2001) introduced the term agile in 2001 as an alternative approach to traditional document-driven approaches such as waterfall approach to provide better flexibility and adaptability to change in customer requirements.

One of the major deficiencies in the agile project management is the lack of appropriate governance processes that are necessary to minimize the risk and increase project success. Hence, some PMPs argue that agile approaches such as Scrum should be combined with an approach like PRINCE2 to account for this drawback (Tomanek and Juricek, 2015). In summary, agile principles provide a framework for planning and assigning tasks correctly, and managing change appropriately, whereas PRINCE2 provides the appropriate governance and management processes (Fance, 2010).

It has been shown that the combination of agile and lean principals in software development is very efficient (Dingsøyr et al., 2012). Lean aims to increase value while at the same time reducing waste (Agarwal et al., 2006). Waste is viewed as any activity or process that consumes time and other valuable resources without adding value to the customer (Petersen and Wohlin, 2011).

Some researchers argued that Lean and Agile cannot be combined in the manufacturing sector because Lean manufacturing depends on stable requirements and plans (Naylor et al., 1999). However, this is not true for software development industry or ERP implementations where the stable requirement and prospective planning does not play any role in these industries (Conboy, 2009). (Fagerholm et al., 2015) reports that combining Lean and Agile also affects the project team's productivity as well as the overall development process.

2.4 Current ERP Implementation Process

Many ERP implementations projects are following one of the standard project management methodologies. Every organisation has its unique goals and each implementation requires careful planning and analysis to allow for alterations with the change of conditions and requirements evolvement during implementation.

A thorough review of the literature revealed that there is no single common process used for implementing an ERP system. For example, (Iba, 2006) developed a generic implementation process based on the works of ERP life cycle and Ehie and Madsen (2005) developed a profoundly interesting five-stage ERP implementation process diagram.

2.4.1 ERP Implementations Framework in Literature

Despite the large body of research on ERP implementation frameworks and methodologies, most of them have focused on identifying critical success factors (CSFs) and providing isolated solutions for each factor or group of factors in some cases. This section presents a review for some of the available ERP implementation frameworks in academic and industrial fields, and it aims to accumulate a vision of the used approaches and techniques.

Some researches focus on a specific phase of the implementation, however; only limited number of papers developed an implementation framework that covers the whole ERP implementation lifecycle. The analysis follows the guidelines of Kitchenham and Charters (2007) to capture the developed ERP implementation frameworks and critically analyse them. The proceeding sub-sections have been ascribed for each stage and a detailed discussion has been provided.

2.4.1.1 Research Questions

The research protocol aims to extract answers to specific questions regarding the characteristics of the implementation frameworks developed by research

papers retrieved and were eligible to be included in the study as per the inclusion criteria mentioned in section 5.2.2. These research questions are:

RQ1. What is the structure of the developed ERP implementation frameworks?

- For each identified framework/methodology, what are the number of phases / stages and how many activities in each phase?
- What are the names of each phase and activity?
- For each identified framework, is there a mention for Pre- implementation or post- implementation phase?

RQ2. What are the major characteristics of each framework?

- What project management approach used in each framework if any?
- What methods are used for the validation of results; theoretical or case study?
- Does the study cover specific ERP vendor? If yes, which one?

RQ3. Which frameworks have additional components to the basic phases and activities?

- What other components are used in the framework (i.e.; change management or business process reengineering)?
- Does the study include the use of any lean principles or tools?

2.4.1.2 Search Protocol

An automatic searching was based on five main sources of scientific papers databases: Scopus, Web of Science, ACM Digital Library, Science Direct, and Google scholar. The review included literature published during 30 years timeframe (from 1986 to 2016) reporting on research issues for ERP implementation. A set of search terms was used based on the research questions Table (5-1) demonstrate the terms and their classification. Search for the terms is limited to the “Title”, “Abstract”, and Key Words fields.

Table 2-2: List of search terms

Classification	Keywords
System	ERP, Enterprise resource planning, IS, OR, Information System
Segments	Implementation, Rollout
Method Name	Framework, Model, Lifecycle, Methodology, Method, Phase, Stages, Process, Strategy

The search string is formed in the following way: (ERP OR “Enterprise resource planning” OR IS OR “Information System”) AND ((Implementation OR Rollout) AND (Framework OR Model OR Lifecycle OR Methodology OR Method OR Phase OR Process OR Strategy OR Phase OR Stage)).

To identify the primary papers that help in answering the research questions, researchers are required to define number of criteria to avoid bias judgment (Kitchenham and Charters, 2007). Eligibility criteria are set to include peer-reviewed journal papers that discuss and present a form of a process for ERP system implementation. To form a comprehensive view of the literature, the search is to cover the last three decades (from 1996 to 2016) because researchers starts focusing on implementation processes and how they take place after the mid 90’s, and before that it was mainly critical success factors (Aladwani, 2001). Table (5-2) summarise the list of inclusion and exclusion criteria.

The retrieved search results were exported to Microsoft Excel where duplicate entries were removed, then titles and abstracts for unique entries were obtained and used for eligibility check. Based on the title and abstract, full-text version of potentially eligible papers were collected to a reference manager (Mendeley) where further in-depth eligibility check is performed and papers were arranged and classified accordingly. Literature review could be developed according to the conscious selection approach by the researcher in order to target the related and essential articles (Cooper, 1988).

Table 2-3: Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
Journal papers	Conference papers
Published between 1996-2016	Non- indexed articles
Written in English	Books and Books chapters
Clearly discuss ERP implementation process	Grey literature
Primary studies	Duplicated studies
	Papers whose full text not available

2.4.1.3 Search Results

Out of the 3,457 primary search results, 1,625 unique entries found. Based on title abstract, and key words, 85 papers were retrieved as potentially eligible from for the mentioned search. On further refining after in-depth reading of the retrieved papers, 18 publications were found eligible to be included in this review. The search and filtration process is summarized in Figure (5-1) whereas Table (5-3) lists the eligible papers and briefly describes each of them.

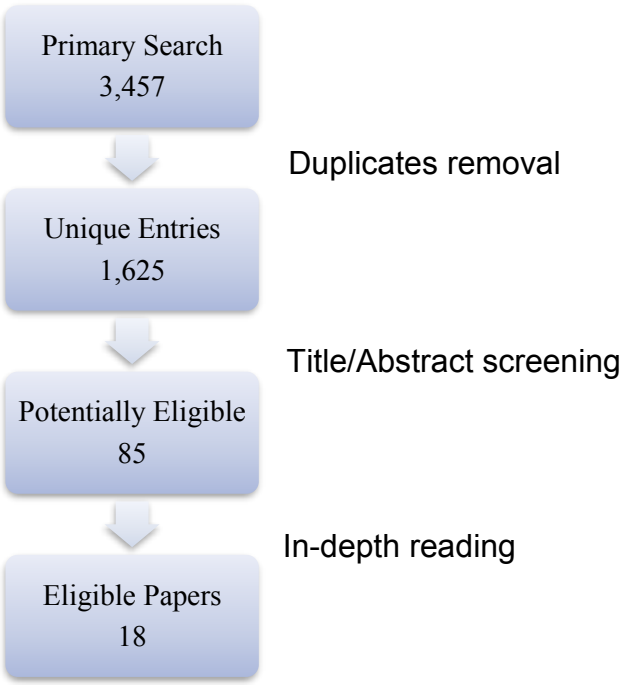


Figure 2-3: Search and filtration process and results of this review

Table 2-4: List of eligible papers – *In chronological order*

Author	Year	Title	Description
Shin & Lee	1996	A Process Model of Application Software Package Acquisition and implementation	Expanded Utterback's implementation model into a procedure consisting of three phases, seven sub phases, and 25 activities.
Parr & Shanks	2000	A model of ERP project implementation	Presents a project phase model (PPM) of ERP implementation projects that is a synthesis of existing ERP implementation process models and focuses on the implementation project
Somers *et al.*	2000	Enterprise Resource Planning (ERP) for the Next Millenium: Development of an Integrative Framework and Implications for Research	Proposes an integrative framework derived from the socio-technical view of organizations that illustrates the multifaceted nature of ERP implementations
Al-Mudimigh *et al.*	2001	ERP software implementation: an integrative framework	Propose an integrative framework with six dominant CSFs and three levels with number of activates in each level
Rajagopal	2002	An innovation—diffusion view of implementation of enterprise resource planning (ERP) systems and development of a research model	Used a six-stage IT implementation model and applied it to different case studies to develop a causal model for understanding contextual factors of ERP implementation
Umble *et al.*	2003	Enterprise resource planning: Implementation procedures and critical success factors	Identifies success factors, software selection steps, and implementation procedures critical to a successful ERP implementation with case study presentation
Yusuf *et al.*	2004	Enterprise information systems project implementation: A case study of ERP in Rolls-Royce	Presents a brief overview of the application of SAP R/3, an ERP software package, and takes an in-depth look at the issues behind the process of ERP implementation via a case study methodology
Bajwa *et al*	2004	An integrative framework for the assimilation of Enterprise Resource Planning Systems: Phases, Antecedents, and Outcomes	Presented a five phases framework based on logically related activities and a set of antecedents that influence those activities
Berchet *et al.*	2005	The implementation and deployment of an ERP system: An industrial case study	Proposes a five-stage model for integration and deployment of an ERP system at a telecommunication company
Ehie & Madsen	2005	Identifying critical issues in enterprise resource planning	Describes a five-steps implementation process that

		(ERP) implementation	delineates the critical issues driving successful implementation of ERP systems
Zhang *et al.*	2005	A framework of ERP systems implementation success in China: An empirical study	Develops an ERP implementation success framework by the adaptation of an information systems research model and a success model to identify both critical success factors and success measures
Metaxiotis et al.	2005	Goal directed project management methodology for the support of ERP implementation and optimal adaptation procedure	Implementation methodology based on GDPM principles. And augmented with the five steps of ERP IOA.
Peslak *et al.*	2008	The phases of ERP software implementation and maintenance: A model for predicting preferred ERP use	Used a systematic development theory to build a model of four phases
Chofreh *et al*	2011	Enterprise Resource Planning (ERP) Implementation Process: Project Management Perspective	A theoretical framework based on the PMBOK project lifecycle. It has five phases
Schniederjans & Yadav	2013	Successful ERP implementation: an integrative model (TOE)	Present a conceptual model with three constructs. And introduced "Trust" as a new CSF
Sun *et al.*	2015	A step-by-step performance assessment and improvement method for ERP implementation: Action case studies in Chinese companies	Developed a five-stage ERP implementation model. And elaborated CSFs into KPIs and associated them with each stage
Chang *et al.*	2015	A novel model to implement ERP based on dynamic capabilities: A case study of an IC design company	Propose a model with five stages using the dynamic capability theory.
Chofreh *et al*	2016	A Master Plan for the Implementation of Sustainable Enterprise Resource Planning Systems (Part II)	Conceptual framework structured in three phases pre-implementation, implementation, and post-implementation. And number of stages

Each eligible paper is summarised to understand the content and form some answers for the research questions. The summary of each paper is presented below.

Shin & Lee (1996) Proposed an ASP acquisition and implementation procedure consisting of three phases, seven sub phases and 25 activities, and the model is based on a previous model of Utterback. The three main phases of the model are: Project formulation, ASP Acquisition and Installation, and Post-

implementation use. The activities are summarized and mapped within a particular sequence. They argue that if top management devoted more effort the quality of the implemented system will increase. The seven sub phases are: Project Initiation, Requirements Analysis, Preparation, Selection, Acquisition, Installation, and Post-implementation use.

Parr & Shanks (2000): Presented a view of the implementation process that is focused on the individual discrete phases of the implementation project itself and propose a PPM to provide guidance for successful ERP implementation. The PPM has three major phases: planning, project and enhancement. Since the model focuses on the project phase, it has been divided into several sub phases.

After developing the model phases, authors use previously CSFs to link them to relevant phases of the PPM. They identified those factors that were necessary to achieve success but nevertheless not sufficient to ensure successful outcome. The relationship between these CSFs and PPM phases was drown from data collected by interviewing different stakeholders in two different companies that were used as case studies to validate the PPM.

Somers *et al.*, 2000: The authors propose a socio-technical model of systems development to ERP implementation. This model provides a basis for developing CSF/implementation stage model that accounts for the chronological order of the implementation process.

The developed model was a 6-phase model. The phases were: initiation, adoption, adaptation, acceptance, routinization and infusion. Also, CSFs associated with ERP implementation were identified and empirically validated. However, the project doesn't provide insights about the activities within individual phases and their relationship to success. The authors recommend that further research to be conducted for better understanding of such activities and success factors.

Al-Mudimigh *et al.* (2001): Developed an integrative framework with six dominant CSFs that span across all the stages of the implementation process.

The phases are represented in three levels namely; Strategic, Tactical, and Operation levels, and activates; where each level constitutes of number of activates. One of the major features of the framework is the concurrent application of planning and performing that lead to the synchronies ion the various activities and ensuring all projects' teams are working for a common goal. The proposed framework emphasizes on importance of risk management throughout the implementation lifecycle.

Rajagopal, 2002: In this research, a stage process model was used to explain the various contextual factors associated with the innovation and diffusion of various types of ERP systems and the resulting enhanced performance. Then a research causal model was developed using findings from case studies of 6 manufacturing firms that have one of the widely used ERP systems. The model encompasses six phases: Initiation, Adoption, Adaptation, Acceptance, Routinization, and Infusion.

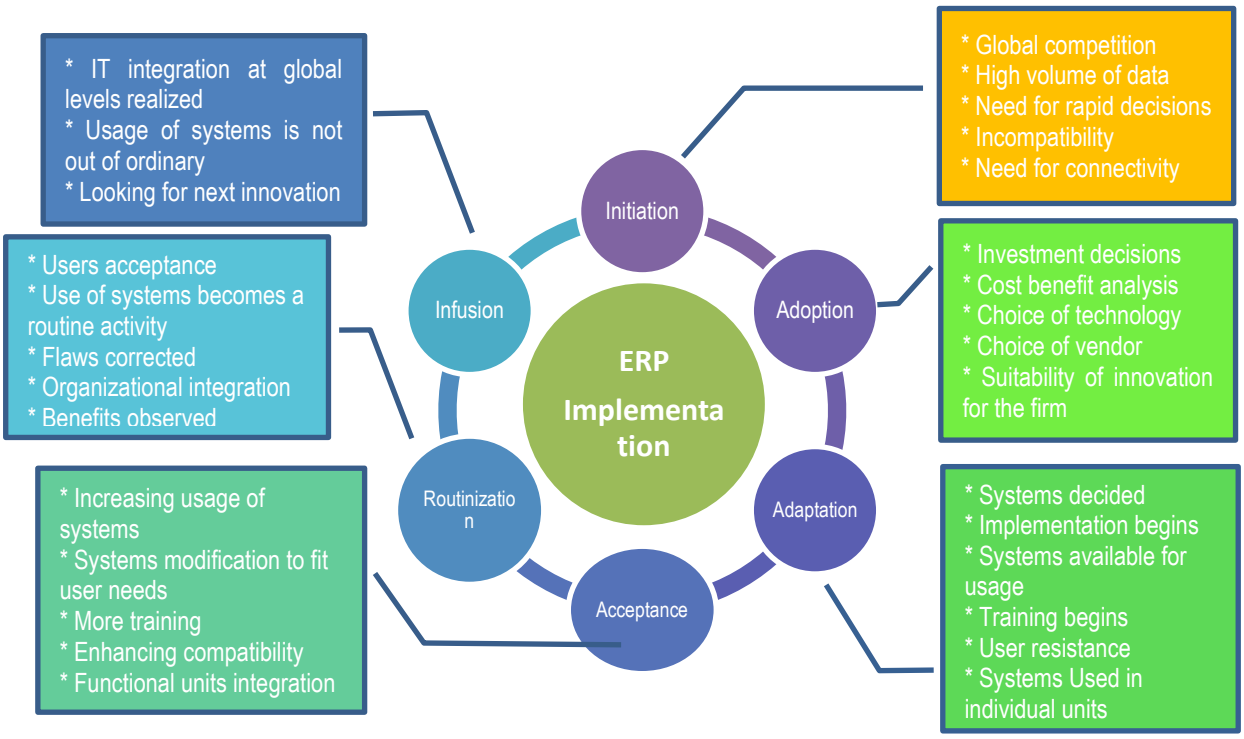


Figure 2-4: Stage model and activities, Rajagopal (2002)

The uniqueness of this research paper is that it combines both the process and causal models while utilizing innovation–diffusion based stage theory to establish a framework for implementation of ERP systems. Figure (5-2) summarizes the stage model and activities as it applies to ERP implementation.

Umble *et al.*, 2003: In this Paper, clear steps for the software selection and the implementation procedure are recommended based on authors' experience and literature review on CSFs and implementation steps. Although the framework doesn't have clear phases, it entitles a detailed step-by-step approach for successful ERP implementation from software selection to post implementation audit. They compiled a list of 11 recommended implementation steps that have been integrated from several works. Authors also strongly highlight several success factors including quality of project management and the organizational change management.

From the study of the successful implementation case, the authors conclude that the one of the important factors for such success was the company's culture. Another factor that was highlighted as a strong contributor to the success was the effective project management. The company established a Project Management Office. It was responsible for with communication and coordination of resources. The team used a very effective tool that was establishing an intranet web site for the consolidation of information. The Project management office was also responsible for the forward transfer of knowledge gained from early phases of implementation to later ones.

Yusuf *et al.*, 2004: Authors of this paper have identified core issues in successful ERP implementation based on a case study of a large manufacturing organization. They extensively describe the implementation project within the company, the problems and risks associated with the implementation project and how the company could manage to overcome them.

Implementation framework was organized in three phases. Phase 1, Strategy and direction, was a short and intensive study for the purpose of setting the

scope of the project and providing an outline of the plan and cost estimation. An "ERP core team" was established with the main function of controlling and overseeing the implementation process. The second phase involved creating a detailed plan and installing a prototype system.

The third phase (implementation) was too large to be implemented at once so it was divided into two waves. Wave was concerned with the replacement of legacy systems.

Bajwa *et al (2004)*: Presented a five phases framework namely; Awareness, Selection, Preparation, Implementation, and Operation. They conceptualized the ERP phases based on logically related activities and a unique set of motives that influence those activities. Their preparation phase includes, unlike other frameworks, training of implementation teams and system prototyping. This phase also starts the gap analysis and business process reengineering in order to realize the outcome of "As Is / To Be" concepts.

Berchet *et al.*, 2005: This article presents a case study of ERP implementation with focus on integration and deployment. The authors propose a five-stage implementation model: Selection of the vendor and software, Deployment and integration, Stabilization, Progression, and Evolution.

Phase 1 (selection of the vendor and software) requires that the expression of requirements and specifications to be clearly defined, the objectives to be fixed and the budget to be elaborated for the contracts to be established. The integration and deployment phase involves the following steps:

- General Design: where the different process within the company were defined and formalized.
- Detailed design, realization, and prototype validation; the activities of this step are: unit testing, specific developing, definition of end user authorizations, definition of the process starting, writing guides for users, preparation of user training, building of integration test scenarios.

- Implementation of the solution: this step involves testing and final validation of the prototype.
- Starting preparation: the time for real start testing.
- User training: a key step for ERP implementation success.

The third phase was the stabilization phase during which users understand, assimilate, and then appropriate their new tool. Phase 4 is the progression phase where key users clearly detected the key processes of improvement. In the final stage (evolution) key users control the tool in their area of skills perfectly, in terms of advantages and disadvantages of the ERP system. They can then propose important evolutions of the IS in order to optimize the ERP deployment process.

Ehie *et al.*, 2005: This study proposes a five stage ERP implementation model that was developed from literature review and interviews conducted with experienced ERP consultants. The phases are preceded by a critical look at a company's strategic enterprise architecture and surrounded by change management and business development components. The change management component seeks to integrate human resource dimension while business development component coordinates daily operations with the new business process design.

In phase one, project preparation, an exhaustive planning process involving people, assigning leadership roles, specifying budget targets, and establishing the plan of the project. In second phase, the business blueprint, the existing system process is being analysed to provide the background for ERP system selection before comprehensive training on functions and configuration gives the project team the needed knowledge to plan the new business process design. An excellent project management framework acts as a significant factor for enhancing the chance of overall success with an ERP system.

The third phase, realization, focuses establishing the technical bases while testing each process design on a conference room pilot. In the fourth phase, final preparation, the whole procedure design integration is tested under full

data load and extreme situations. At the same time, the intended system users and those influenced by the system will go through the training needed to understand how data flow through the system and how the system is operated at each point in the supply chain. Finally, the go live and support phase focuses on optimizing process flow and on the continuous expansion of the system to enjoy new competitive advantages.

Zhe Zhang *et al.,* (2005): This study develops an ERP implementation success framework by adapting the Ives *et al* (1980) information systems (ISs) research model and DeLone and McLean's (1992) IS success model to identify both critical success factors and success measures which are used to suggest an ERP implementation methodology. The implemented systems in the studied enterprises have gone live no more than two years before the study initiation.

The authors cite business process re-engineering as a critical factor to the success of the implementation project. They argue that one of the principal reasons of ERP implementation failure is that organizations simply under estimate the extent to which they should change and re-engineer the existing business processes to accommodate their purchase. Another important factor in this context is the effective project management with five major parts considered essential for success: having a formal implementation plan, a realistic time frame, having periodic project status meetings, having an effective project leader who is also a champion and having project team members who are stakeholders. Based on findings from case studies, the authors recommend a 3-phase implementation framework and identify the impact of CSFs across these stages.

Metaxiotis et al. (2005) Developed an ERP implementation methodology based on the principles of Goal Directed Project Management (GDPM), an overview is depicted in Table (5-4). Along with GDPM, they augmented the process of implementation and optimal adaptation (IOA).

ERP IOA lifecycle has five steps: Marketing and presales, Proposal, Contract, Completion, and Accomplishment. This methodology is based on the vendor's perspective and it is very effective and supports the implementation process.

Table 2-5: Goal Directed Project Management structure

	Planning	Organisation	Control
Global Level (Project level)	Project Mandate Milestone Plan	Project Responsibility Chart	Milestone Report
Detail Level (Activity level)	Activity List Bar Chart	Activity Responsibility Chart	Activity Report

Peslak *et al.* (2008): Used a systematic development theory to build a model of four phases, the model is an extension for Parr and Shanks (2000) mode where they split the "Project" phase into two phases. The proposed phases are Preparation & training, Transition, Performance & usefulness, and Maintenance.

The model was validated through a case study that was implementing SAP system. Through confirmatory factor analysis, they verified that preferred ERP use influenced by the two phases; Preparation & training and Performance & usefulness.

Chofreh et al. (2011): Propose a theoretical framework for ERP Implementation Process based on the five phases of the PMBOK project lifecycle, the phases are Initiating, Planning, Executing, Controlling, and Closing. They incorporated the nine knowledge areas of PMBOK guide in each phase, these knowledge areas are: integration, scope, time, Cost, Communications, Quality, Human Resource, Risk Management, and Procurement. They proposed each phase as a stand-alone project and that the outcome of each project / phase feed into the succeeding one. The paper mentions a validation for the framework with a case study company, however, no form of proper validation and results are presented in the paper.

The paper of **Schniederjans and Yadav (2013)** illustrates a conceptual model with three constructs: technology, organization, and environment and it incorporates some of the critical success factors necessary to achieve success.

A new critical success factor is introduced in the paper, which is the trust with the vendor and consultant.

Sun et al. (2015): developed a five-stage ERP implementation model namely; ERP Organisational Readiness, Selection, Implementation, Final Preparation, and Live-run. They elaborated 80 critical success factors into key performance indices (KPIs), and then they associated these CSFs with each stage of ERP implementation. The model calculates the weights of the KPIs to assess the performance at each stage. This model provides performance assessment and improvement method.

Chang *et al.* (2015): Propose an implementation model with five stages using the dynamic capability theory as a theoretical foundation. The stages are: Establishment of the objectives of the implementation, Assessment of the available resources and the scope of the implementation, Process redesign/integration and organizational learning, System implementation, and Measurement and evaluation of performance.

The paper divides the corporate resources into three categories; Technology, Human, and Business resources, then they identified the dynamic capabilities of these resources.

Chofreh et al. (2016): Introduce a conceptual framework of the Sustainable ERP (S-ERP) that is structured in three phases pre-implementation, implementation, and post-implementation. Each phase consists of number of stages and Monitoring and Controlling stage that run across all phases.

The concept of project management is the base of the framework design, which will enable the handling of project complexity. They argue that S-ERP will help systematise and integrate the sustainability strategy into the daily practices of the organisations

2.4.2 Analysis of findings

As a result of conducting a state of the art scientific review of literature, a profound understanding of the essential constituents of ERP implementation

and its relevant associative topics was achieved. Data were extracted from the included studies according to aforementioned literature review research questions. Some of the papers presented their models/frameworks in a descriptive way, while others chose the graphical representations. The following sections summarize the answers for these questions as per our findings.

2.4.2.1 Phases and Activities

The analysis of the studied frameworks revealed large varieties in the number of phases and in the naming of these phases as well. This section will depict the commonalities and variances of phases in each framework.

Shanks & Parr (2000) presented an implementation process that encloses two concepts: first, the implementation phases and corresponding activities, second, CSFs were analysed to determine which CSF is most important in which phase of the implementation project. The PPM has three major phases: planning, project, and enhancement. Since the model focuses on the project phase, it has been divided into several sub phases.

Somers, Nelson and Ragowsky, (2000) and Rajagopal (2002) developed a six phase model, the phases were: Initiation, Adoption, Adaptation, Acceptance, Routinization, and Infusion. The model of Somers, Nelson and Ragowsky, (2000) provides a basis for developing implementation stage model that accounts for the temporal of the implementation process. Also, CSFs associated with ERP implementation were identified and empirically validated. However, the stage model of Rajagopal (2002) was used to explain the various contextual factors associated with the innovation and diffusion of various types of ERP systems and the resulting enhanced performance. Then a research (causal) model was developed using findings from case studies.

Unlike the previous frameworks, Umble, Haft and Umble, (2003) have presented a list of 11 recommended steps for a step-by-step approach successful implementation based on authors' experience and literature review on CSFs and implementation steps. Although the framework doesn't have clear

phases, it entitles a detailed approach for successful ERP implementation from software selection to post implementation audit, these steps have been integrated from several works.

Yusuf, Gunasekaran and Abthorpe, (2004) have identified a three phases Implementation framework: Strategy and direction, Planning and prototyping, and implementation. Number of activities carried out through the second phase included:

- Preliminary design review: developing a design and implementation strategy, defining the scope of the project, and developing the business process model.
- High-level design review: analyse the enterprise model, and develop 'Vanilla' prototype.
- Critical design review: detailed design and customization of the prototype.
- Implementation realization: integration testing.
- Technical/operation review: user acceptance testing.
- Post implementation review: system deployment, systems conversion, and user training before the 'Go Live'.

Berchet and Habchi, (2005) presented a case study of ERP implementation at Alcatel, a telecommunications company, with focus on integration and deployment. The study covered the deployment of the SAP R/3 software package. The authors propose a five-stage implementation model: selection of the vendor and software, deployment and integration, stabilization, progression and evolution.

Ehie et al (2005). presented an implementation model with five stages: project preparation, business blueprint, realization, final preparation, and go live and support. The model was developed from literature review and interviews conducted with ERP consultants. Change management and business development components surround the phases. The change management component seeks to integrate human resource dimension while business

development component coordinates daily operations with the new business process design.

(Zhang et al., 2005) developed a 3-phase ERP implementation framework to identify both critical success factors and success measures. They identify the activities within each phase as the following:

- Selection: Partnership, solution, and agreement.
- Implementation: Preliminary model, final solution, operational system.
- Optimization: Enhanced operation, enhanced control, and enhanced business performance.

The study was based on case studies of four Chinese companies that have implemented at least the basic modules of the three major integral parts of the Baan ERP system.

2.4.2.2 Pre- and post-implementation phases

Most of the studies included within this systematic review did not state separate phases for the pre- and post-implementation phases. However, some of the studies recommended activities that seem similar to those in pre- and post-implementation phases with variable nomenclature.

Parr and Shanks, (2000) named the pre-implementation phase as planning that included activities like selection of an ERP, assembly of steering committee, determination of project scope and implementation approach, selection of project team manager, and resources determination. The post-implementation phase of this model was called enhancement where system repair, extension, and transformation take place.

Somers et al (2000) and Rajagopal et al (2002) propose the same phases for the implementation model. Their model encompasses a pre-implementation phase (initiation) driven by many factors such as increased competition at the global level, the increasing need for a more rapid and informed decision making process, incompatibility issues and the need for more effective communication

between functional units of the enterprise. A post implementation phase was also outlined (Infusion) where the benefits of implementation project are being harvest and the driving force for the next IT innovation project is developing.

Umble et al (2003) explained clear steps for software selection (pre-implementation) but didn't include a phase that encompasses post-implementation activities. The software selection steps were: creating the vision, creating feature list, creating software candidate list, selection of serious candidates, requesting proposals, reviewing proposals, selection of 3 or 3 finalists, having the finalists demonstrate their packages, selection of the winner, justification of the investment, negotiating the contract, running a pre-implementation pilot, validating the justification.

Similar to Umble et al (2003), the model Yusuf et al (2004) doesn't feature a post-implementation assessment and modification phase. However, a pre-implementation phase was named strategy and direction and included activities of setting the scope of the project and providing an outline of the plan and cost estimation. It also includes the establishment of an "ERP core team" the controls and oversees the implementation process.

Berchet et al (2005) enumerated the pre-implementation activities under the selection of vendor and software phase that is analogue to Umble's pre-implementation phase. The activities of the post-implementation stage were spread over three phases, namely, stabilization, progression, and evolution. Similarly, Ehie et al. grouped the pre-implementation activities under the phase of project preparation and the post-implementation activities were grouped under go live and support phase.

Zhe Zhang et al (2005) has also recommended a pre-implementation phase called selection, concerned with activities of selecting a specific ERP software, and post implementation phase called optimization concerned with the enhancement of operation, control, and overall business performance.

2.4.2.3 Framework Validation

Parr & Shanks (2000) model was validated using to case studies of companies that represent a successful and an unsuccessful implementation projects. The success was defined as the ability to complete the project on time on budget not the impact of implementation on company's performance. Somers et al (2000) and Ehie et al (2005) did validate their model neither empirically nor theoretically. Rajagopal et al (2002) validated their model through case studies in six companies that have recently implemented an ERP system. Similarly; Umble et al (2003) validated their model through a case study of a company that has successfully implemented Baan ERP package, Yusuf et al (2004) validated their model through a case study of a large manufacturing organization who has successfully implemented the SAP software package, and Berchet et al (2005) validate their model through a case study at Alcatel telecommunication company. Finally, Zhe Zhang et al (2005) used case studies from four Chinese companies that have implemented an ERP system to develop and validate the model.

2.4.2.4 ERP Vendors

Ten out of the 18 studies included in this systematic review developed an implementation approach that covers a specific ERP vendor. Three vendors are exclusively studies in the included literature, namely SAP, Oracle, and Baan. Table (5-5) summarizes the specific vendors studied as per each included paper. It shows that SAP is the most commonly studies software in ERP implementation framework development followed by Baan and least commonly the Oracle software.

Table 2-6: ERP vendors covered in each of the studied papers

ERP Vendor	Paper
SAP	Yusuf *et al.*(2004), Berchet *et al.*(2005), Sun *et al.*(2015)
Oracle	Peslak *et al.*(2008)
Baan	Zhang et al. (2005), Chang *et al.*(2015)

SAP, Oracle, Bann	Rajagopal (2002)
SAP & Baan	Umble et al. (2003)
None	Shin & Lee (1996), Parr & Shanks (2000), Somers et al. (2000), Al-Mudimigh *et al.* (2001), Bajwa *et al* (2004), Ehie et al. (2005), Metaxiotis et al. (2005) Schniederjans & Yadav (2013),

2.4.2.5 Change Management

Umble et al (2003) used their case study of the successful implementation experiment, to conclude that the one of the important factors for such success was the company's culture that was receptive to change. For several years, the company had accepted and implemented a program of monthly ''kaizen breakthrough events'' for the purpose of lean manufacturing. These events utilize teams, composed of six to ten shop floor employees, executives, customers, and suppliers, who were responsible for the analysis, redesign, and implementation of improvements in several manufacturing or business processes.

2.4.2.6 Business process re-engineering

Zhe Zhang et al (2005) cite business process re-engineering as a critical factor to the success of the implementation project. They argue that one of the principal reasons of ERP implementation failure is that organizations simply under estimate the extent to which they should change and re-engineer the existing business processes to accommodate their purchase. Parr & Shanks (2000) PPM includes a sub-phase that has an additional component of business process re-engineering.

2.4.2.7 Project management

Umble et al (2003) highlighted effective project management as a strong contributor to the success of ERP implementation. The company in the case study established a Project Management Office that was responsible for with communication and coordination of resources. The team used a very effective tool that was establishing an intranet web site for the consolidation of

information. The web site contained telephone directories, travel policies, weekly project update reports from all sites of the corporation where the new project is being rolled out, and an issues resolution database. This way, answers to frequently asked questions (FAQs) and previously solved problems, could be easily accessed. The Project management office was also responsible for the forward transfer of knowledge gained from early phases of implementation to later ones.

2.5 Organisation Readiness for ERP

Most of the ERP implementation failures are not related to technical and system factors rather they are related to organizational, cultural, and behavioural factors. (Ravasan and Mansouri, 2016) (Momoh, Roy and Shehab, 2010). Organisations are recommended to perform a readiness assessment prior to the start of the ERP implementation process to be able to identify weakness areas. If organisations are able to assess their capabilities and readiness for ERP implementation prior to instigating the project, it will help them to take proactive correctives measures and eventually minimise failure risks (Ahmadi et al., 2015). Because of the complexity of ERP systems, implementers need to assess the readiness of the organization as one of the first steps of the project (Shiri, Anvari and Soltani, 2014). (Shafaei and Dabiri, 2008) argue that lack of organizational readiness in terms of maturity of the business process is one of the reasons for ERP implementation failure, thus evaluating the enterprise readiness is vital to the success of the implementation project. (Hidayanto et al., 2013) recommend the introduction of readiness assessment as a separate stage in ERP projects and before the implementation phase, they assert that readiness assessment helps to identify the organisation's capability and areas of improvement as well. (Ravasan and Mansouri, 2016) developed a model to measure the relationships between 27 critical success factors (CSFs) for ERP implementation and project failure. They revealed that "ERP readiness assessment" factor has the highest effect on the project failure among other factors.

Academics and practitioners comprehensively cover the research on ERP implementation, and ERP readiness is one of the latest emerging areas of study in this field. Several authors have surveyed the ERP implementation literature and provided different types of approaches which include: bibliography listing, qualitative, or quantitative (Schlichter & Kraemmergaard 2010). Due to the high failure rate in ERP implementations, vast numbers of research projects were carried out identifying and investigating the critical success factors (CSFs) of ERP Implementations (Fui-Hoon Nah, Janet Lee-Shang Lau 2001; Somers & Nelson 2001; Finney & Corbett 2007; Dezdar & Sulaiman 2009; Momoh et al. 2010; Al-Mashari et al. 2003). In some instances, academics could refer to similar CSF using diverse terminology and some set several CSFs into one CSF (Dawson & Owens 2008). Despite great efforts spent on analysing and improving implementation of ERP systems, the literature review revealed minimal efforts has been made to the study the development of ERP frameworks or models to manage the implementation process and directly improve the success rate. (Dong 2001) presented a conceptual model of exploring impacts of top management on enterprise system implementation effectiveness. (Wei & Wang 2004) developed a framework based on data obtained from external professionals' reports and internal interviews with vendors to select a suitable ERP system. (Zhang et al. 2005) produced an ERP implementation success framework by adopting an information systems success model. (King & Burgess 2006) presented a new model that draws upon simulation ideas in order to better understand the relationships between CSFs and exploring for more appropriate implementation strategies. (Hakim & Hakim 2010) provided a strategic modelling plan for decision-makers to take precise steps in implementing ERP systems and decrease risks. Project Resource Planning method (PRP), Analytic Hierarchy Process (AHP), fuzzy AHP and Analytic Network Process (ANP)-based methodologies were used by (Vayvay, Ozcan and Cruz-Cunha, 2012) for the consultant selection decision. (Schniederjans & Yadav 2013) used Technology, Organisation, and Environment (TOE) framework to develop a conceptual model that better defines critical success factors in ERP implementation. (Zeng & Skibniewski

2013) recommend a probabilistic risk assessment approach for ERP implementation, which models the connection between ERP system components and certain risk elements.

Researchers covered the area of ERP readiness from several diverse perspectives; followings are some of the major studies. Ravasan & Mansouri, (2016) developed a dynamic ERP critical failure factors modelling with 27 factors.

(Wognum et al., 2004) developed a framework to assess the readiness of organisations to implement enterprise systems in general and not only ERP. The framework consists of three dimensions and six aspects and uses a chain technique of (Cause- Event- Action- Outcome). The ERP readiness assessment framework developed by (Raymond, Rivard and Jutras, 2006) consists of four dimensions and 13 factors with three readiness levels.

Shafaei and Dabiri (2008) developed an assessment model based on the European Foundation for Quality Management (EFQM) Excellence model for effective and successful ERP implementation. They identified the preliminary relations between 40 ERP's critical success factors and the enabler's criteria of the EFQM, then they validated these relations through interviews with experts from industry and academia. The final model consists of 6 criteria that include a total of 27 elements, and all elements contain 194 guidance points in total. The research by Kwahk and Lee (2008) extended the Technology Acceptance Model (TAM) to investigate the ERP implementation readiness and they were able to identify the causal relationships between the employees' attitudes and the readiness of an organization. A readiness assessment framework based on fuzzy analytic network process is developed by (Razmi, Sangari and Ghodsi, 2009), whereas, (Hanafizadeh and Ravasan, 2011) used the McKinsey 7S Model to develop their readiness assessment framework that calculates the contribution weight of the factors on the overall readiness. (Hidayanto et al., 2013) extended the ERP readiness assessment framework developed by (Razmi, Sangari and Ghodsi, 2009) and apply it to a software development company as a case study. They scrutinised the readiness factors then grouped

them into three categories, namely project management, organizational, and change management readiness.

Ahmadi et al. (2015) developed a new approach for managing interrelated readiness improvement activities using fuzzy cognitive maps (FCMs) and the fuzzy analytical hierarchy process (FAHP). Then, they applied the FCM–FAHP approach to a medium size service company to assess how readiness-relevant activities will contribute to the overall readiness. The study of (Hajilari, Ghadaksa and Fasghandis, 2017) designed a model with six fuzzy expert systems that are allocated in two levels.

To summarise, the number of studies in this area reflects the significance of ERP readiness assessment to the success of implementation projects. Exploring the above-mentioned studies on ERP readiness assessment reveal that different approaches and techniques such as ANP, FCM, EFQM, and TAM are used in each model, however, none of the models used lean principles and tools.

2.6 Change Management Models

There are a number of change management models and frameworks that are used in practice. To explore the available change management models and analyse their main pros and cones, the researcher reviewed the literature and employed a content analysis method through application of the qualitative approach. Content analysis is fundamentally an exploratory method that provides understanding on insight, opinions, and issues related to the selected topic that aids in developing ideas for potential research (Taylor et al. 2015).

In this research, the qualitative data were collected via secondary resources. The secondary sources used in this study were, published and cited research works available in a database such as Scopus, Taylor & Francis, Elsevier, Springer, Science Direct, Association for Computing Machinery (ACM) Digital Library, and the search engine Google Scholar. The assessment of secondary data aids the researcher in gathering thorough knowledge on the change management of research and increased understanding. The collected

qualitative data on change models are comparatively analysed based on variable matrix inclusive of features, strategies, advantages, disadvantages and degree of applicability. The variable matrix measures the difference among the application of change management.

Comparative analyses of most commonly used change models are discussed here after.

2.6.1 Lewin's Change Management Model

Kurt Lewin has developed a very simple change development model which is a practical model for understanding the process of change. This model has three strategic phases; Unfreezing, Changing and Refreezing (Longo, 2011).

The main advantage of this model is that it provides a comprehensible summary of both supporting and is a very ration and objective oriented model (Burnes, 2004). The main disadvantage is its requirement of complete participation of employees in gathering accurate information regarding the change. The model is mostly applied in organizations with the traditional approaches, such as top-down approach, command-control style management, that have segmented and small units with slow change timeline (Hossan, 2015).

2.6.2 McKinsey 7 S Model

McKinsey's model is considered as a tool that analyses organizational change by considering seven key internal elements namely, Strategy, Structure, Systems, Shared values, Style, Staff and Skills (Jurevicius, 2013).

The main advantage of this model is that it provides a strategic implementation of organizational change as well as facilitates inter-organizational communication and coordination (Jurevicius, 2013). Another advantage of this model is that it can put the findings of academic research into practice (Quarterly, 2008). The main disadvantage is the need for synchronization in all the elements for better execution of the change model (Quarterly, 2008). The McKinsey's 7S model is applied in checking readiness for the change in any organization (Alshaher, 2013).

2.6.3 ADKAR model

The **Prosci ADKAR** model was created by Jeff Hiatt as an objective-oriented model of change management that is used in organizational change (Prosci 2002). This model provides clear objectives and outcomes of the organizational change management and provides a framework for every level of the organization. This model is effective because it understands the impact of change on individuals related to the organization and ambiguously facilitates by providing change implementation structure and direction (Hiatt, 2006). As per ADKAR model, change happens in two dimensions namely business/project side of change and people side of change, and both are required for successful change implementation (Hiatt, 2006).

The main advantage of ADKAR model is that it encapsulates both the business and individual dimension of change and provides a clear plan of action. The main disadvantage is that it does not include the role of leadership in the change model (look for ref.). This model of change is applied in workplace health promotion programs (Michaels and Greene, 2013), technology road mapping (Gerdsri, Assakul and Vatananan, 2010), in developing a shared governance culture (Shepherd et al., 2014) and many more.

2.6.4 Bridges' Transition Model

William Bridges developed this Transition Model in 1991 and the main characteristic of this model is that it is more focused on transition instead of change. The difference between Change and Transition is that the change will happen even if everyone does not agree with it people (Brisson-Banks 2010). On the other hand, transition is internal and related to stages of transition. This model outlines three stages of transition; Ending Zone, Neutral Zone and New Beginning stage (Brisson-Banks, 2010).

The main advantage of this model it provides an understanding of the people's attitude towards change and its psychological effects. This is limited in approaches to change management and cannot be used independently

(Tremolada, 2015). This is a transition model used in dealing with the transitional phase of change on organizational as well as individual level.

2.6.5 Kotter's Change Model

Kotter´s model of change is an eight-step model first introduced in 1996, then it is developed farther in 2012 and the eight-step became the eight Accelerators (Venkateswaran, 2014). The main advantage here is that this model deals with both the change and transition process and main criticism is that it is a bit mechanical process.

A qualitative comparative study of all the models is performed for this study using post-positivist approach. The features, stages, advantages, disadvantages, and applications of the change models have been comprehensively presented in this study, Table (2-5) depicts the list of change models with comparative analysis**.**

Table (2-6) depicts that the main advantage of Kotter's over other models is that it brings together both change model and transition model.

This model is a stepwise model that provides clear guidelines for each step. It is not mainly focused on change itself like other discussed model but its main focus is to accept the change by preparing for change itself rather than changing for it. Strength of Kotter's model over other models is that this model fits well in hierarchal culture of the organizations (Gough, 2009).

Table 2-7: Comparative Presentation of Relevance of Change Models

Parameters / Model	Transition Strategy	Time Consumed	Advantages	Shortcomings	Degree of Applicability
Kotter's Model	Linear simple model focused on importance of change	Good for long term projects	Deals with both the change and transition process	Mechanical process	Applied in top-down change processes
Lewin's Change Management Model	Concept based on the transformation of ice cube through process of unfreezing, Changing and refreezing	Initial stage is more time consuming than the rest	Rational and objective oriented approach	Requirement of complete participation of employees	Mostly applied in organization with traditional organizational structure
McKinsey 7 S Model	Understanding the relation between inter-organizational elements	Strategy, system and structure are the time consuming elements	Strategic implementation of organizational change	Need of proper synchronization in all the elements	Mainly applied in checking readiness of the system for the change
ADKAR model	Builds change capability to engage employees through change.	-	A clear plan of action for both business and people dimension	No role of leadership specified	Applied in promotion programs, technology road mapping and shared governance
Bridges' Transition Model	It explores human behaviours relevant to the change	It is a time consuming model as the process of transition occurs slowly	Understanding of attitude towards change and psychological effects	Limited only to transition phase and not independent	In transitional phase of organizational change at individual and organization level.

This is a linear model that focuses on the importance of benefits related to the change and is relatively simple than other models, like nudge theory as well as works well in organizations with a relatively small organizational structure. It is effective because it understands the impact of change on individuals related to

the organization and ambiguously facilitates by providing change implementation structure and direction (Nauheimer, 2009).

The major strength of Kotter's model lies in the first two step namely, establishing a sense of urgency and creation of the guiding coalition (Gough, 2009). As this model is appropriate for the organization having top-down organizational structure, it can prohibit the unwanted interference from other levels of the organization

If too many leaders are included in the change that can cause organizational upheaval, this can be avoided by the use of Kotter's change management model and environment for change requirement can be established that can genuinely engage a broader group of employees in the process of change. Another step of this change model i.e., creating guiding coalition, can aid in the selection of change agent that have skill and insight to implement a successful organizational change (Gough, 2009).

2.7 Lean Overview

The topics discussed in the previous sections are common in the ERP implementation literature, but exploring the topic of lean thinking is almost rare. Since the aim of this research is to develop a lean based framework to manage ERP implementations, the following sections will scrutinise the area of lean principles and tools covering its different implementations.

2.7.1 Lean history and Background

Toyota Production System (TPS) started in Japan during the mid-1940s to help Toyota manages the global challenges and competition of automotive industry. During an economic crisis in mid 1970s many Japanese business experienced monetary losses, Toyota however despite the crisis was able to pass through this crisis successfully. Japanese industries re-centralised their focus and placed attention on the TPS as a means to solve their predicaments. TPS further evolved in to lean manufacturing and lean production in 1988, and by the

early 1990s, lean concepts started to spread to a variety of industries and in many countries across the globe. The term “Lean Production” was first introduced in a book titled “The Machine that Changed the World” (Womack et al. 2008). The book is the summary of results for a five years research project known as the International Motor Vehicle Program (IMVP) and initiated by Massachusetts Institute of Technology (MIT) in 1985.

Toyota’s new approach formed its basis of lean as the endeavour to minimise waste in all areas of operations. They responded to their customer’s expectation of high quality products in the most efficient way. Shigeo Shingo one of Toyota’s industrial engineer like many at the company bluntly refused ‘to accept waste as unavoidable’ (Pavnaskar et al. 2003). By developing the functionality of the tools involved in manufacture, Ohno reduced cost while diversifying and increasing output. The introduction of lean principles has been accordingly adopted across a number of sectors and industries, from increased floor space, machine availability and productivity through to a reduction of defects and cycle times (Pavnaskar et al. 2003).

2.7.2 The five principles of lean

There are five principles that guide a lean concept through the stages of implementation; they were identified by (Womack et al.; 1990). While not the easiest to achieve, the methodology adds real-time val ue to both the organisation and user/customer. The principles are:

Specify value accurately.
Identify the entire value stream.
Make value flow without interruption.
Let the customer pull value.
Pursue Perfection.

The process should begin again and repeated until perfection has been reached - a perfect value being when no waste is created

2.7.3 Lean core values and wastes

Shingo and Ohno (Shingo, 1992) highlighted seven areas in manufacturing where waste can stagnate or even halt progress; Defects Overproduction, Motion, Waiting Time, Transport, Processing, Inventory. Any one working with lean is tasked with identifying areas of waste to increase efficiency (Womack et al 2008, Liker 1998).

Revealing and classifying areas of waste is of little value to an organisation unless eliminated (Pavnaskar et al. 2003). Without a clear understanding of which tools to employ, confusion ensues and loss of confidence in the model is highly likely to occur. The likes of Taylor and Brunt (2001) have simplified this for organisations seeking to 'get lean' by connecting the seven basic waste groups highlighted by Shingo and Ohno (Shingo, 1992) to seven different value stream mapping tools with their simple correlation matrix (Pavnaskar et al. 2003).

2.7.4 Critical Success Factors for Lean Transformation

Realising the benefits of lean principles, many organisations instigated lean transformation initiatives. Regardless of the numerous endeavours to implement lean transformation programs in manufacturing and non-manufacturing sectors, the number of failed transformation is high (Netland, 2016). The nature of lean transformation projects entails substantial organisational change, and (Kotter, 1996) asserts that more than 60% of organisational change projects fail. Thus, the lean critical success factors (CSF) has been studied and scrutinised by academics and practitioners, this section explores the lean CSF literature.

(Alefari, Salonitis and Xu, 2017) conducted a survey within manufacturing firms and concluded that leadership and top management is the key success factor for introducing and implementing lean manufacturing, mainly for SMEs.

Tortorella and Fettermann (2018) searched the literature and identified nine CSFs that promote help chain, and then assessed the relationships between these factors. The identified factors are: Communication, Training, Discipline, Sense of urgency, Support of other areas, Knowledge and focus on the flow,

Quality tools application, Follow-up routine and analysis, and Leadership. They developed an instrument for assessing the relationships and then empirically validated the tool with 50 manufacturing firms.

The research of ((Netland, Schloetzer and Ferdows, 2015), 2016), surveyed practitioners from 83 factories to identify the CSFs for implementing lean production. Then, they tested the identified CSFs for differences across four contingency variables: corporation, factory size, stage of lean implementation and national culture. Finally, they studied how these contingency variables influence lean implementation CSFs. In the IT service sector, (Kundu and Manohar, 2012) reviewed the literature of the CSFs in manufacturing sector and identified eight CSFs which they believe to be applicable in the IT support service enterprises. The factors are: Management leadership, Management support, Top management commitment, Organizational Culture, Communication, Training and Skill Building, Financial Capability, Measurement Framework. Achanga et al., (2006) researched the area of lean CSFs using comprehensive literature review and field visits to ten manufacturing SMEs. They were able to identify four key success factors: Leadership & management, financial capabilities, organisational culture, and skills and expertise, and their findings assert that Leadership & management is the most critical factor. Similarly, Laureani & Jiju Antony (2018) advocates that the leadership CSF is the most important factor for effective deployment of Lean Six Sigma. They conducted a longitudinal study survey questionnaire and exploratory factor analysis and identified four CSFs: project management, leadership, selection of top talented people and financial accountability.

Moreover, (Kobus and Westner, 2015) extracted 13 CSFs for implementing lean Management in IT organizations, and then they consolidated these factors into three dimensions: Mind set and behaviour; Organization and skills; and Process facilitation and performance management. They related the existing information systems theory to the identified CSFs in order to explain the theoretical foundation. (Haley, 2014) conducted a literature review analysing archival secondary data to identify CSFs for implementing lean philosophies in

information technology field. They assessed nine essential CSFs using the analogy of plyometric the most effective factors. This step led to a model for implementation with the following seven factors: enterprise incorporation, team trust, transformational leadership, recursive improvement, integrated synergy, customer-centric culture, and heuristic communication.

Umble et al. used their case study of the successful implementation experiment, to conclude that the one of the important factors for such success was the company's culture that was receptive to change. For several years, the company had accepted and implemented a program of monthly ''kaizen breakthrough events'' for the purpose of lean manufacturing. These events utilize teams, composed of six to ten shop floor employees, executives, customers, and suppliers, who were responsible for the analysis, redesign, and implementation of improvements in several manufacturing or business processes.

2.7.5 Leanness Assessment

With the dissemination of lean principles in the manufacturing industry and the start of adoption of the concept by non-manufacturing businesses, the need to assess the performance arose. Organisations started looking for ways to evaluate their investments in lean initiatives and to measure how effective and efficient the lean transformation are (Bayou and de Korvin, 2008).

Leanness as a term was instigated in the literature by researchers when they start studying the area of measuring and assessing lean initiatives. The perception of the concept of leanness was not unified in the literature, and very few papers stated a definition for leanness assessment. (Narayanamurthy and Gurumurthy, 2016), define leanness assessment as "a procedure to estimate the level of leanness attained, either qualitatively or quantitatively or both". While the definition provided by (Omogbai and Salonitis, 2016) is "the sum of weighted scores of performance variables that describe the lean manufacturing characteristics of a system". Wong, Ignatius and Soh, (2014) define lean as the extent of lean's adaption level at the organisation. Moreover, leanness is defined as the assessment of lean practices in an organisation or a process

(Bayou & de Korvin 2008), and the valuation of lean practice performance at the organisation Vinodh and Chintha (2011).

Many scholars have addressed the topic of developing leanness assessment tools and models, where multiple approaches and criteria were used in designing these models. (Stone, 2012) analysed the literature of lean manufacturing between 1970 and 2010 and segmented them into five phases; Discovery phase, Dissemination phase, Implementation phase, Enterprise phase, and Performance phase. This logical segmentation reflects the natural progress in development and spreading of the lean philosophy. (Oleghe and Salonitis, 2018) conducted a literature review for the leanness assessment models in manufacturing organisations. They noticed that most frameworks are using either quantitative or qualitative leanness indicators, and very few are using a combination of both. They also concluded that the assessments are mainly conducted on the current status bus not the future improved state. A second literature review by (Narayanamurthy and Gurumurthy, 2016) analysed the developed leanness assessment models based on five attributes; Organization type, Methodology adopted, Data collection method, Benchmarking, and Numerical index. Their results indicate that 13% of the developed models are in non-manufacturing sector, and 74% used quantitative approach.

Following is an exploration for some of the published leanness assessment models in the literature. Gonçalves and Salonitis, (2017) developed a lean assessment tool for workstation design of assembly lines using factors based on lean and ergonomic aspects, and then he validated the tool at an automotive assembly line. The tool consists of a checklist with seven key factors; Health and Safety, Work environment, Cleanliness & orderliness, Waste elimination, Inventory & material logistics, Flexibility, Visual Management, and Quality. People of the organisation were requested to evaluate the factors through 150 “True or False” questions. The model developed by Oleghe and Salonitis, (2016) calculate the lean index of the manufacturing organisation using quantitative fuzzy logic. Moreover, the model introduced by Vinodh and Chintha

(2011) uses fuzzy logic approach in calculating the leanness index in manufacturing. The model is structured in three consecutive levels namely; enablers, criteria, and attributes. The model is validated at an electronics manufacturer where the leanness index was determined.

One of the early developed assessment tools is the Lean Enterprise Self-Assessment Tool (LESAT) by Nightingale and Mize (2002). It is designed to assess the leanness at the aerospace industry for three processes; enterprise leadership processes, life-cycle processes, and enabling infrastructure processes. Additionally, Soriano-Meier and Forrester, (2002) designed a leanness assessment model with a qualitative approach to evaluate the degree of adoption of lean practices by organization. The assessing factors of model contains nine lean practices, and it is validated at ceramic tableware manufacturers. The leanness assessment model developed by Bayou and De Korvin, (2008) adopts fuzzy-logic methodology to find the degree of leanness level. Using the date of Honda Motor as a benchmark, they calculated the leanness index for the two American manufacturers Ford Motor and General Motors.

In summary, the reviewed literature revealed that assessing the leanness of the process helps in identifying the areas of underperformance and improves them. It could be concluded that there are varieties of methods and criteria to evaluate the leanness of processes at organisations; these factors depend on the industry and process types.

The approach used in this research is adopted in the development of the leanness model is based on the works of (Vinodh and Chintha, 2011) with certain alterations to suit the nature of the research.

2.8 Lean for ERP Implementation

2.8.1 Lean in none-manufacturing

The application and utilisation of lean principles in any industry other than manufacturing holds it pertinent to use the same set of lean tools and methods (from manufacturing) and implement them accordingly. The instantaneous

reaction would deem unsatisfactory, therefore the adaptation and manipulation of the tools according to the nature of the industry whilst preserving the essence of lean is compulsory.

The use of lean principles to improve processes in industries other than manufacturing has proven to be a success, although it has not been without its fair share of challenges. A review of methodologies being used in public services has demonstrated that over half of the texts being considered focused on lean principles, showing it to be the preferred approach (Radnor, Holweg and Waring, 2012). Moreover, A research by (Marodin and Saurin, 2013) studied the adaptation of lean production to sectors other than manufacturing, and they identified the associated difficulties and opportunities.

During the last ten years, any organisations from a diverse spectrum of industries have started to reap the benefits of implementing lean, these sectors include: health care, education, construction, IT and banking which has streamline their processes. The movement of lean principles into non-manufacturing industries is growing and more businesses are implementing the principle in order to obtain the benefits.

Souza (2009) research was able to identify 90 articles with reference to lean healthcare, which were published in ten countries over the period of 2002 - 2009, and the number of publications seems to be increasing annually, indicating the increased number of lean initiatives in healthcare. The Royal Bolton NHS Foundation Trust in the UK, Virginia Mason Medical Centre in Seattle (USA) and Flinders in Australia are good examples of successful lean implementation in the healthcare industry. As a result of adopting lean, there has been 'reduced waiting time, reduction of errors and increased employee motivation whilst increasing customer satisfaction' (Radnor, Holweg and Waring, 2012).

Piercy & Rich (2009) reported that three financial institutions implemented lean concepts in their call centres and achieved major improvements. After implementing lean principles, all three companies attained many benefits. The

advantage of quality improvement, operational cost reduction and high workplace morale, resulted in a reduction of staff absenteeism and turnover.

The lean methodology lends itself well to the construction industry. Outlining clear objectives throughout the life cycle of the project, members of the workforce are able to maximise their performance. Using the lean model in construction generally results in projects being not only easier to manage but safer, more cost effective and of superior quality (Aziz & Hafez, 2013).

Lean IT has started in the last five years, which will help the IT industry adopt a culture of continuous improvement, working towards high performance.

The published articles are in support of Lean within the IT industry, its five principle model is readily welcomed by clients and companies alike. Offering full transparency, work can be carried out swiftly, initiating the flow and in line with their customers 'pull' ensuring they stay within budget (Hurwitz & Demacopoulos, 2009).

2.8.2 Lean in software development and IT

Software engineering and lean methodology is a story primed for success. The five principles of lean can easily be translated and applied to software development. Where manufacturing saw waste in inventory, Software development sees waste in incomplete work. Overproduction in a manufacturing plant is the same as creating extra (unnecessary) features within a program, while task switching is comparable to the waste inherent in transportation (Poppendieck *et al,* 2003).

Turner & Lane (2013) wrote an article titled "applying lean principles to coordinate multi-level systems engineering in large enterprises" and stated that lean principles are highly effective in many instances of software development. Another study stated that for a successful implementation of IT system in an organisation, a lean transformation initiative should precede.

When a group of engineers at Wipro Technologies made use of visual control boards (VCB) during the creative process, their ability to spot defects as they

occurred improved quality by promoting greater clarity (Staats, Brunner and Upton, 2011). In software development project it is important to focus on the most important functionality, get it completed and then go on to the next most valuable work by looking at the workflow and attend to the cost of delays. (Poppendieck and Poppendieck, 2003).

Having identified the diverse benefits of lean principles as obtained by multiple industries, the author believes there is an opportunity to extend beyond the current ERP implementation processes by utilising Lean thinking as a means to minimise failures and achieving higher success rates. However, the greater challenge is not in transposing the lean principles from manufacturing in to another business department, but in establishing the necessary environment to ensure the successful transition.

Lean principles have been applied in many non-manufacturing industries, however, no research studied applying lean principles in managing ERP / systems implementations.

2.8.3 Challenges of Applying Lean Principles in ERP

ERP implementation is a complex and lengthy process that involves many variables and covers many functionalities across an organization (Iba, 2006) Momo 2015). In spite of the large number of ERP implementations over the last three decades, the failure rate is still very high. It is imperative that all parties concerned to strive to find techniques and solutions to increase the success rate of ERP implementations in order to benefit from the cost and effort.

Likewise, the lean transformation process is not a simple one and it requires considerable dedication and commitment (Achanga et al., 2006). As mentioned in section 2.5, lean IT is a new approach that has started within the last five years in organizations to help them advance towards high performance. Considering the current critical success factors for ERP implementation along with other general conditions, it would be practical to use Lean principles to address these challenges. The challenges of using lean principles in ERP implementations in order to increase the success rate are as follows:

Lack of change management: Effective change management is essential to manage end users resistance to change (Ahmed, Zbib and Arokiasamy, 2006). Lean employs a systematic process approach, with one of its basic requirements being the existence of change management. The challenge is in avoiding conflicts in change management policies in case there is more than one initiative taking place at the same time.

Excessive customization: Standardization is one of the 5S tool of lean, it is required to build a careful balance between ERP functionality and the business processes. ERP customization is acceptable to an extent without jeopardizing the core functionality(Hicks, 2007).

Dilemma of internal integration: ERP implementations usually involves large number of stakeholders in the organization, and the extent of internal integration is always debatable (Momoh, Roy and Shehab, 2010). Using value stream mapping and creating flow steps may solve the dilemma (Hurwitz and Demacopoulos, 2009).

Poor understanding of business implications and requirements: Business requirements is a crucial factor, but its importance is usually under - estimated. Business and IT do not talk the same language (technical vs. non-technical), and this should be realized when developing the Customer Specification Document (CSD). Kaizen could a useful concept to handle this challenge.

Poor data quality: Original data should be thoroughly analysed and evaluated for its quality and format, and then data migration should be well planned to avoid corruption of data. Quality filter mapping is one of the effective tools of lean, a quality, fast and repeatable migration process could be used to address this challenge (Bradley, 2007).

Lack of literature reviews: Using lean principles to manage the ERP implementation process is a new approach. It is not yet possible to conduct a meaningful literature review as nothing has been written on this subject. All the

major databases were searched for any form of literature (including Journal papers, books and conference papers) but no material was uncovered.

Organization should have Lean principles in place: For an organization to use lean principles for ERP implementation it should already have applied lean principles throughout the organization; this is because both lean and ERP implementation affect the entire organization (including processes, people, and culture). It will be very challenging to develop a framework that is usable by both types of organization.

Long duration for ERP implementation process: ERP implementation projects usually take between 18 and 30 months, depending on organization's size and the implementation approach and complexity. Lean implementations are carried out in work places such as factories, offices, hospitals or education institutions and ERP implementation is a process that occurs over a long period of time. A Kanban-based Scheduling System (KSS) with pull approach was applied on system engineering, it is believed that KSS can provide more realistic understanding of work in progress and organizational capacity (Turner and Lane, 2013).

Three parties: who should lead: Lean is a process for continuous improvement that is normally led by the organization itself throughout its internal departments, which then reaches suppliers and customers. In the case of ERP implementation, it is the vendor and consultant who have the know-how, and the challenge is to develop a framework that produces an effective approach.

Modification of Lean tools: Due to the difference in nature between the ERP implementation process and a lean workplace, it is necessary to modify some of lean tools so as to be able to use them in the ERP implementation process. The challenge is to develop a framework with no, or minimum modifications, in order to maintain the values of Lean principles and tools.

In summary, using Lean principles in ERP implementation processes could help in reducing the failure rate of these implementations, however, there are some challenges. Addressing these challenges in more detail and carrying out further

research would provide an excellent opportunity to increase the percentage of successful ERP implementations.

2.9 Research Gaps

The comprehensive review of scientific literature has identified number of trends and research key gaps, which are listed below:

1. The ERP implementation process is complex and challenging and more than 50% of these projects fail to achieve their intended goals. However, there is a lack of well-designed implementation frameworks that resulted in increasing the success rate of these projects.
2. Lean thinking is relatively new to the IT industry and most ERP practitioners have limited knowledge of lean philosophy. There is a need to introduce lean principles in context with IT projects and landscape.
3. Assessing organisational readiness for ERP implementation is an essential factor for the success of the project. Although scholars have developed some readiness assessment models, the literature revealed that no model has been developed using lean criteria and perspective.
4. There are many similarities in the critical success factors of ERP implementations and lean transformations; however, there is a lack in research on utilising this similarity to improve ERP implementation success rate.
5. Lean principles have been applied in many non-manufacturing industries; however, no research studied applying lean principles in managing ERP / systems implementations.
6. There is no research effort in mapping the current practices of the ERP implementation processes against the lean principles, and the development of lean assessment mechanism.
7. The previous literature did not research the application of value stream mapping tool (VSM) to identify wasteful activities in the traditional ERP implementation process. There is a need to assess the ERP implementation process using VSM tool for waste elimination.

2.10 Summary

Extensive literature reviews help the researcher form a thorough understanding of the topic's context and identify potential areas for research. It leads to identifying the most important issues and their relevance to the work, which allow the researcher to map the field and position the research within its context. Furthermore, the literature review enables exploring similar work done, compare previous findings, and anticipate future directions, which construct the ability to substantiate the research hypotheses. Finally, one of the key objectives for reviewing the literature is to identify knowledge gaps that demand further investigation, and hence contribute to the knowledge by filling that gap.

This chapter covers the literature review related to the research context; it explored number of areas that deemed essential in scrutinizing the intended subject. The main objectives of the chapter are to identify the research gaps through the understanding of available research in the area of ERP implementation and lean management. There are three main parts that constructed this chapter; the first part is covering ERP system and its implementation. The Second Part is dedicated to investigating the concept of lean and its implementation in non-manufacturing industry. And the final part of the chapter presents the research gap and its analysis; following are the points that summarise the main topics:

- To form a clear understanding for the ERP system, the chapter presented the history and evolution of ERP, its major components, and the critical success factors for implementing the system.
- The different ERP implementation approaches such as (Big bang, Modular, and Geographical) are discussed, followed by the implementation processes which covered ERP life cycle as well as the various stages and phases of the system implementation. Then all the stakeholders involved in ERP projects are identified and the importance of the role of each stakeholder is discussed.
- The organisation's readiness for ERP implementation is a key element for the success of the projects; hence, it is advantageous if organisations

can assess their readiness and take some precautionary measures. A reediness assessment model helps implementers form a clear vision and identify the strong and week areas at the organisation beforehand.

- All ERP implementation projects follow a form of project management methodology depending on the project manager and the culture of the organisation. Waterfall methodology is one of the very early methods used in managing IT projects, and Agile project management is the latest. Exploring the procedures and guides for the different approaches enable the researcher to accumulate the knowledge that form the foundation for developing a new framework.
- Managing change is vital during ERP implementations; but most of the times it is not adequately addressed. This chapter discussed the topic of change management and reflected on its importance and benefits. Additionally, numbers of the most common change models are presented and described their characteristics and pros and cons.
- The concept of lean is reviewed in the literature where its history is documented and its five principles were presented in detail. The definition of value and types of waste are discussed in the chapter followed by the critical success factors for lean implementation.
- Furthermore, the researcher discussed the leanness assessment concept and how it evolved. Then, the literature is searched for the available assessment tools and models where their features and techniques are analysed. It has been noticed that there are resemblances between the readiness and leanness assessment concepts.
- The section before last investigated the application of lean philosophy in the IT industry in general and with ERP implementations in specific. The literature revealed that lean principles have been used in areas of IT sectors such as software development and service disc management. However, lean thinking is not used in ERP implementation projects.

Chapter 3

RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this chapter is to provide a detailed account of the methodology adopted by the author in achieving the research aim and objectives. The chapter has been segmented in to the following order: in continuation from the introduction, section 3.2 discusses the research purpose, design, strategy and the data collection techniques in context of this study with a rationale for the associative selection of methods. Drawing references to the research objectives, an overview of the adopted research methodology has been presented in section 3.3, followed by a chapter summary in section 3.4.

3.2 Research methodology overview

Clarification of the context of the research is essential in order to formulate an appropriate research methodology, through which the research aim and objectives will be achieved. The centralised theme of this research is ERP implementation; other research areas such as lean thinking and change management are intertwined and can be considered equally essential. Successful research rests upon the completion of five fundamental components that include: research purpose, conceptual context (e.g. theoretical and practical background), research question, methods and validity (Bickman & Rog, 1997) which will form the discussion of this chapter.

3.2.1 Research Purpose and Application

Robson (2002) suggests the initiation of any research must begin with the establishment of the research purpose which is typically classified as: exploratory which develops on the understanding of the current state and endeavours to propose new understandings and as a result generates a hypothesis, explanatory, which provides a detailed account of a given situation or predicament and aims to establish theoretical correlations between information and descriptive provides in-depth details of a situation, experience or an individual.

With reference to the research aim and objectives, it can be inferred that exploratory and explanatory are both relevant for this particular research. The initial stages of the research will take on an exploratory route in order to establish the current ERP implementation practices from scientific literature as well as industry (see research objective 1) followed by explanatory, which is more relatable in identification of lean tools/techniques that could be utilised for waste elimination whilst mapping complexity attributes of the ERP implementation process (see objectives 2 and 3).

Research can be categorised into two specific domains i.e. pure research and applied research. The former deals with the expansion of current knowledge or seek the unknown, whilst the latter which is more relevant to this study aims to develop practical solutions for given predicaments.

3.2.2 Research Design

The design of the research revolves around two distinct approaches, namely, qualitative and quantitative (Walsh, 2001; Burns 2000; Kumar, 2005). The representation of the research acquired from a quantitative approach is expressed numerically and is obtained from a prearranged and controlled setting i.e. variables and is usually considered ‘detached’ in order to minimise the levels of interference and influence (Robson, 2002). Qualitative research however is different to the aforementioned; emphasis is placed rather on the experience, contextual and linguistic interpretations of the participant(s) and

usually direct quotations are used to form the basis of discussion and its prevailing judgement. The progression of qualitative research follows a more evolutionary development, which is incremental, as the research progresses – the research problems become clearer (Creswell, 1998). The distinction between the two approaches has been illustrated in Table (3.1).

Table 3-1: Distinction between Qualitative and Quantitative approaches (Adopted from Burns, 2002)

Description	Qualitative	Quantitative
Assumption	› Reality is more socially constructed › Complexity of variables makes it difficult to measure › Dynamic quality to life	› Facts and sample data have a fixed and objective reality › Variables can be identified and measured › Static approach to life
Purpose	› Seeks to clarify › Aims to contextualise › Captures the understanding of others	› Forms judgements based on predictions › Deals with generalisation › Casual justification
Method	› Data collection: unstructured/informal interviews, observations etc. › Completes with hypothesis and grounded theory › Inductive and naturalistic › Descriptive write up	› Testing and measuring › Finalises with hypothesis and theory › Deductive and experimental › Static analysis › Abstract and impersonal write-up
Role of Researcher	› Researcher instrumentally is involved directly and displays empathy	› Researcher applies formal apparatus and is usually detached and is more objective
Strengths	› Flexible › Very sensitive to surroundings › Accommodates the development of new concepts › Functionally interpretive	› Fixed › Illustrates casual effects › Typically follows a structured approach › More suited for cross comparison
Weaknesses	› Minimal structure in approach › Time consuming › Emergence of bias is possible › Validity and reliability concerns	› Strictly measures objects › Very rigid and does not accommodates flexibility › Totally dependant on valid theories and sample data

Since the nature of research is primarily focused on exploration the author has decided to adopt a hybrid approach which will utilise both qualitative and quantitative approaches wherever most suited in order to extract what will be most beneficial for the research. For example during the research a general questionnaire will be used to gather statistical data in order to capture industrial responses (as a quantitative approach), these results will be further supported by conducting interviews and casual discussions (which is considered a qualitative approach) with a selection of the participants from the questionnaire sample.

3.2.3 Research strategy

Having defined the research, the proceeding step sought to establish a suitable research strategy in order to fully realise the inquiry of the research. Robson (2002) proposes three distinctive research strategies which are: case study, phenomenology study and grounded theory study. After careful consideration of the focus and context of research, the availability of resources and the assigned times frame, the most suited strategy was selected. The author was able to reach this decision by reviewing the works of Creswell (1998) who provides a comparison of the traditional qualitative research strategies, which has been presented in Table (3-2).

Table 3-2: Comparison of qualitative research strategies (Based on the works of Creswell, 1998)

Description	Grounded theory	Case study	Biography	Phenomenology
Focus	Developing a theory grounded in data from the field	Developing an in-depth analysis of a singular or multiple cases	Exploring the life of an individual	Understand the essence of a phenomenon
Discipline origin	Sociology	Political sciences, sociology, urban studies and other social sciences	Anthropology, literature, history, sociology, psychology	Philosophy, sociology, psychology
Data Collection	Interview with 20-30 individuals to saturate categories and detail a theory	Multiple sources, documents, interviews, observations, physical artefacts	Primarily interviews and documents	Long interviews with up to 10 people
Data Analysis	Open coding, Axial coding, selective coding, conditional matrix	Description, themes, assertions	Stories, epiphanies, historical content	Statements, meaning, themes
Narrative	Theory or theoretical model	In-depth study of a case or cases	Detailed picture of an individuals life	Description of the essence of the experience

As highlighted in Table 3-2 the selected strategy was case study due to its direct relevance to the nature of the study. Considering the research on ERP implementation is well established and discussed widely in literature however the work on adopting a lean approach to ERP implementation is still new and lacks theoretical background, it was therefore considered necessary to consider this adaptation. The data collection, data analysis and narrative for case study

will also accommodate the substance required in the development of the framework.

Valuable and new insights can be extracted whilst conducting case studies, however direct and prolonged involvement with external participants poses a possible threat to the research, therefore the possibility of in borne bias will not be overlooked. In order to minimise the possibility of such occurrence(s) certain measures of validity and reliability will be taken in to account. To ensure trustworthiness the researcher will ensure certain pro-active measures are in place, of which some have been discussed in the proceeding section.

3.2.4 Establishing trustworthiness

Validity and generalisability form the two major areas in conformance to trustworthiness. Robson (2002) explains validity as identifying the accuracy and correctness of research; the most common threats associated with validity research are listed below:

- *Reactivity*: the presence of the researcher in the given environment influences the behaviour, mind-set and response of the participants
- *Respondent bias*: withholding essential information from the research and as a result causing obstructiveness, usually this is not personal, this could be triggered due to company policies or other legislative factors
- *Researcher bias*: each research is unique, which includes their persona, mentality level of understanding and the types of questions asked and the manner in which they are asked

In order to minimise the aforementioned threats, the following measures could be enforced:

- *Prolonged involvement*: the time spent with the participants must be focus and kept to moderate limits, excessive intermingling will cause the formation of casual relationships which will hinder the correspondences from the respondents
- *Triangulation*: use variation as a means of enhancing the exactitude of the research by considering multiple forms of sources such as theories, laws, settings etc.

- *Negative case analysis*: Refining theories through constructive criticism and the regular application of theories to negative cases

Robson, (2002)explains generalisability as the application of the research study in multiple context, states, and environments, it has two categories; internal and external. The former covers communities, institution and individuals that are considered outside the boundaries in comparison to those that are involved in the study. The latter is far broader in its reach and deals with categories, types that are beyond the scope. For this research external generalisability will be a challenging to achieve in the given time frame, therefore the research will maintain its focus and remain inclined to internal generalisability.

3.2.5 Data collection methods

The formation and sustained enrichment of any research inquiry rests upon the utilisation of multiple data collection methods, typically the information sought after corresponds to the recipient and the circumstances in which it is required (Robson, 2002). The methods employed by the researcher during the course of this research include: literature review, interviews, focus groups, surveys, observation and document analysis. A brief synopsis of the benefits and the intention for selecting these methods has been discussed below.

- **Literature Review**

A scientific literature review can be explained as a reproducible schema that is concise and systematic for identifying, interpreting, evaluating of archived scientific works by academics (Blaxter, Hughes and Tight, 2010). A literature review serves as a stimulus or a means of strengthening ones awareness as opposed to summarising foregoing research in its respectable domain (Burns, 2000). Literature reviews can be conducted in the form of a self-study for increasing ones own understanding of a particular area of interest or inquiry as explained by (Neuman, 2013) moreover, they can be conducted to interpolate/extrapolate historical developments as well as form comparisons on intellectual arguments.

It is in the interest of this research to utilise this particular data collection method to meet the desired outcome of the first objective. By conducting a comprehensive scientific literature review a deeper understanding on the current ERP implementation process, critical success factors for implementation and to what extent lean type thinking can be applied in the realisation of a cost effective implementation of ERP systems. Chapter two of the thesis primarily focuses on the first objective and adopts this data collection method to arrive at research gaps which are reviewed and generate a direction for further inquiry.

- **Interviews**

The direct nature and interaction associated with interviews makes it a very useful and effective technique for data collection, providing the correct techniques are executed. Interviews vary based on their structure, as explained by Robson (2002), the three commonly known include: fully structured, semi-structured, and unstructured.

During surveys and opinion polls, fully structured interviews are used – the questions are usually predetermined, using fixed language in a prefixed style (Rubin and Rubin, 2012; Robson, 2002).

Semi-structured interviews can be considered flexible, they too contain predetermined and fixed questions however the inquirer has the freedom in word selection and alignment of questions, and this in turn allows the facilitation of understanding and communication on mutual grounds between the interviewer and the interviewee (Burns, 2000).

Unstructured interviews are typically informal with minimal to none conformance to a particular style, selection of wordings or order of questions – allowing for an open expression from the respondent (Creswell, 2012) as a consequence allowing the interviewer to clarify any discrepancies, misunderstandings and as a result gain a personal account (Robson, 2002).

Conducting interviews can be time consuming and strenuous, however this research calls for a direct contact with academics and industrial practitioners i.e.

ERP vendors/consultants/users and therefore makes use of both fully and semi-structured interviews.

- **Observations**

According to (Neuman, 2013), accumulation of inside knowledge can be acquired by means of observations; the final output can be expressed both qualitatively and/or quantitatively. The types of observational studies vary, for example they can be direct/indirect, formal/informal, reactive/non-reactive. It is not deemed necessary to provide a detailed discussion on all the types of observations, conversely during the field study and validation/verification of the proposed ERP framework the most suited forms of observational methods will be used.

- **Documents**

Document analysis refers to the collation and critical/analytical analysis of technical documentation such as technical reports, white papers, legislative documents, letters etc. As a means of gathering primary data, the advantage of the documents is the lack of interference of individuals; this in turns allows the researcher to form a sound judgement on the material in hand. Technical documentation provided by ERP vendors and consultants describes the implementation process, the expected output and ways by which the system(s) can be maintained. Testimonials from organisations that have implemented ERP systems and their overall attitude following the transition and available case studies are some of the types of documents have been reviewed in the proceeding stages of the study. During the research, the author was provided with a number of documents that explain the current processes.

- **Surveys**

By means of using a structured questionnaire, surveys are conducted in to gather data, the different types of surveys include: (1) self-completion whereby the respondent independently completes the questionnaire, (2) fact-to-face where questions are asked and the interviewee replies in the presence of the interviewer, and (3) telephone interview, where the respondent is contacted via telephone and the survey is conducted (Robson, 2002). With the emergence of

readily available web-based and social media platforms the opportunity to conduct surveys globally with geographically dispersed audiences, is now becoming a favourable option. These services provide users with templates to control the design/formatting/content, the target audience, and the method of graphical representation whilst maintaining anonymity to populate a vast data with minimal expenditure.

- **Focus Groups**

Focus group is a useful data collection method which allows a collective response on a particular topic, personal/group feelings, perceptions, interests, opinions and concerns can be easily obtained. As opposed to conducting singular interviews, focus groups can save time and money; however the occurrence of disagreements and irrelevant discussions amongst the participants is possible and distraction from the main focus. Despite these drawbacks, providing the morale and aptitude of the group is recognised by the leader a great deal of useful information can be extracted and the sessions can be used as a means of creative problem solving.

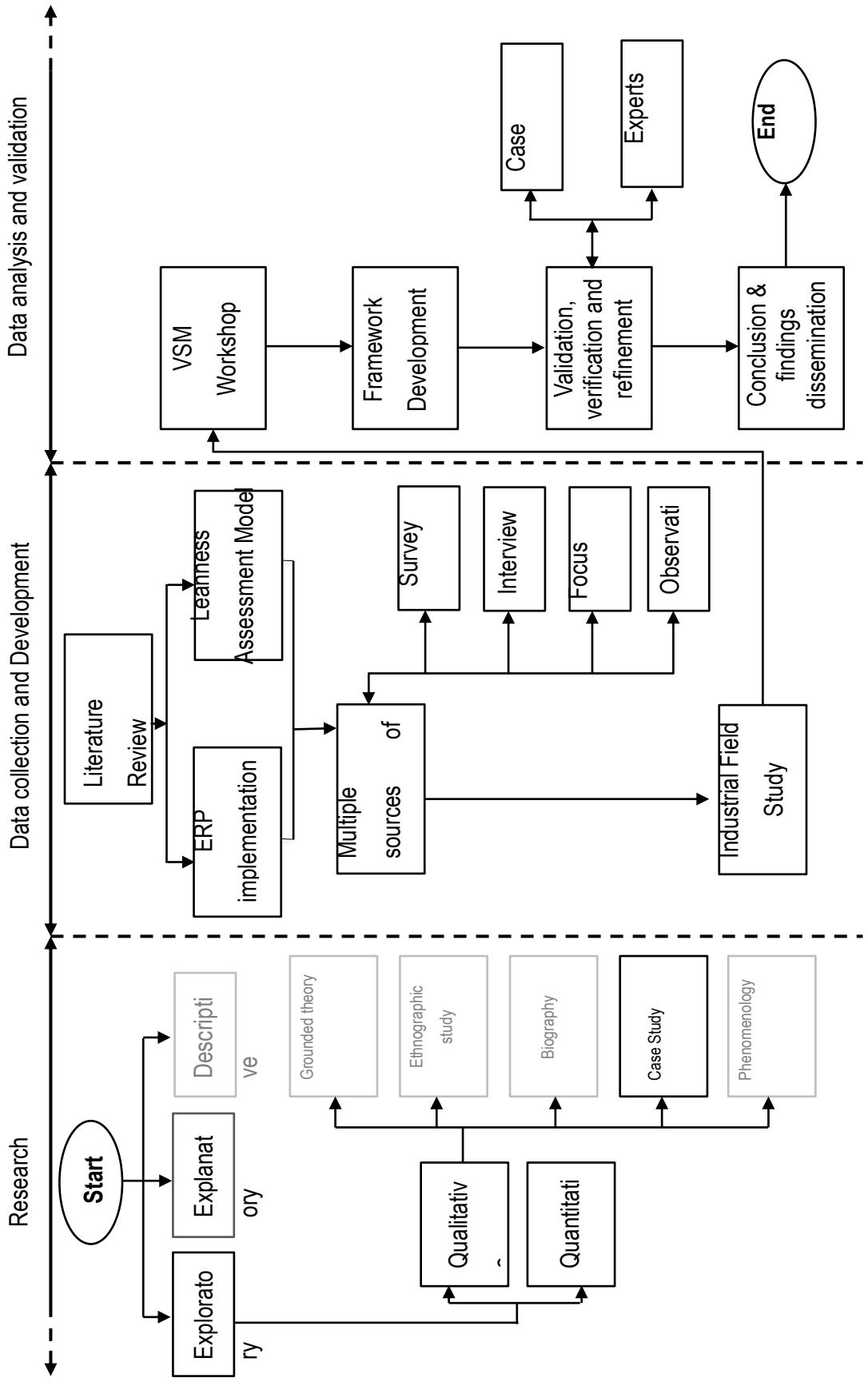


Figure 3-1 Research Methodology Design

3.3 Research methodology adopted

Detailed within this section is the adopted research methodology, Figure 3-1 presents the research methodology design, with indication to the research approach, data collection/development and data analysis and validation stages. Following is a discussion for the four phases of the adopted research methodology.

Phase 1: Project initiation and context definition

The first phase of the research methodology initiates with understanding the context of the subject and establishes the fundamentals of the base for the research. A review of scientific literature is conducted and continues in to the proceeding phase. The key areas covered during the reading included: lean principles and tools, ERP implementation and change management. This was achieved by reviewing scientific publications i.e. journal papers and conference proceedings, books etc., this has been covered in detail in Chapter 2.

The researcher also signed up to online communities including mail groups in both lean and ERP related topics which provided regular updates on events and discussions in these areas. In addition to this; the researcher attended conferences, seminars and workshops to establish network as well as gain direct contact with leading industrial professional that shared common interests. As a result of conducting these activities the authors knowledge was enriched and a deeper understanding of the subject areas was achieved which directly influenced the research.

The fourth activity illustrated in Figure 3-1 is to define the CSFs in ERP implementation; this was achieved through the literature review. Furthermore identifying the weighting for the most relevancy of the CSFs was also categorically achieved, this was achieved through an in depth review of literature with the aid of certain criteria with effective statistical tools.

The final activity of this phase was to identify the current ERP implementation methods used in industry, this initiated with the listing possible respondents and contacting them and inviting them to participate in the study.

Table 3-3: synopsis of activities to be conducted in Phase 1 of research methodology

	No.	Activity	Rationale	Method/tool	Outcome
	1.1	Start Literature Review	To explore the recent academic and empirical research in the subject area and build a state of the art knowledge	Reviewing top ranking journal articles, conference proceedings and relevant books	Understanding the context
	1.2	Identify CSFs for ERP	To identify CSFs that have the highest weight with the most impact on the implementation process	Conduct in depth review for literature using certain criteria with an effective statistical tool	
	1.3	Identify Current ERP implementation processes		Process analysis	
	1.4	Join online related groups	To explore recent practices in the field and follow updated knowledge	LinkedIn, Twitter, Forums, Facebook	Build a network and access to first hand data
	1.5	Attend related workshops & seminars	To establish a network directly with academics and industrial practitioners	Participation in industry related events	

Phase 2: Data Collection and field study

A detailed discussion on the selection of data collection methods has been discussed in Section 3.2.5. A general survey was conducted in the beginning across the ERP industry in order to build a general overview in terms of the perspectives of lean principles in correspondences to ERP implementation. The target audience for the survey included the following: consultants, ERP vendors, and end users (IT and business personnel). Multiple electronic medians were used such as email lists, LinkedIn, Twitter etc. with the intent of generating a high response with the aid of a well-designed survey, and the response was very positive.

The proceeding activity entailed the analysis of the data gathered from the survey; the results of the analysis demonstrated the overall perception of the participants with reference to ERP implementation complexity and highlighted the possibility of lean tool selection for the different stages in the implementation process. Furthermore, the overall response to the need for a new implementation approach/method and to capture, address and provide an

integrative resolution to the challenges in the framework was highly expressed by the respondents. Detailed accounts of the responses from the survey have been recorded in Chapter 4.

Another key activity within this phase was to identify which of the ERP critical success factors could be addressed by lean tools and to what degree they could be improved/ enhanced. This was achieved by reviewing each CSF with from a lean viewpoint and was able to selectively highlight the lean tools that are most applicable in the ERP implementation process that would be used to improve the overall success rate.

Table 3-4: synopsis of activities to be conducted in Phase 2 of research methodology

	No.	Activity	Rationale	Method/tool	Outcome
	2.1	Design questionnaire	Build general overview for the awareness of lean principles in this industry	Electronic questionnaire	Questionnaire format
	2.2	Conduct general survey		Email & social networking media	Survey data
	2.3	Analyse survey data		Stata or SPSS	Identification of framework challenges
	2.4	Define ERP CSFs to be addressed by lean	Shortlist CSFs that could be fixed by applying lean concepts	Review each CSF from lean perspective	List of CSFs
	2.5	Identify lean tools for ERP	Identification of feasible lean tools	Explore lean tools	List of relevant lean tools

Phase 3: Data Analysis

The third phase of the research methodology is primarily concerned with data collection and analysis; it also consists of five activities as highlighted in Figure (3-3) and Table (3-5). Majority of the activities within this phase take on a particular nature whereby the researcher engaged with many personal and the overall approach of the findings are more inclined towards qualitatively. A detailed account of the tasks performed and the companies contacted whilst completing the activities as well as the outcome of the filed study has been recorded in Chapter 4 thoroughly.

Table 3-5: synopsis of activities to be conducted in Phase 3 of research methodology

	No.	Activity	Rationale	Method/tool	Outcome
	3.1	Identify data sources and suitable number of case studies	To conduct a practical survey	Personal network	List of participants
	3.2	Develop/design interview questionnaire	To have comfortable and useful interview	Reading and training	Interview questionnaire
	3.3	Perform face-to-face interviews	To acquire information	semi-structured interview	Interview results
	3.4	Categorise interview data	To help in the analysis	Required tools	Data for analysis
	3.5	Conduct detailed data analysis	To extract results	Statistical package	Results

Phase 4: Framework Development

The final phase of the research methodology is associated with the development and refinement of the framework. The first activity performed was the development of a lean assessment model as part of the framework, a detailed account of how the model was developed has been provided in Chapter 5.

Table 3-6 synopsis of activities to be conducted in Phase 4 of research methodology

	No.	Activity	Rationale	Method/tool	Outcome
	4.1	Define tools to be used in framework	To aid in the development of a working framework	Research and training	List of lean tools
	4.2	Framework/tool development	To find solution for lean ERP implementation	As appropriate	Lean ERP implementation Framework
	4.3	Framework refinement	Gain assurance	Revisions	Final Framework
	4.4	Results validation	To reflect research outcome in real life	Experts review	A tested/working framework

Finally, an illustration of the phases and activities of the research methodology with reference to the research objectives is provided in Figure (3-2) which details the tools/methods required for its successful completion.

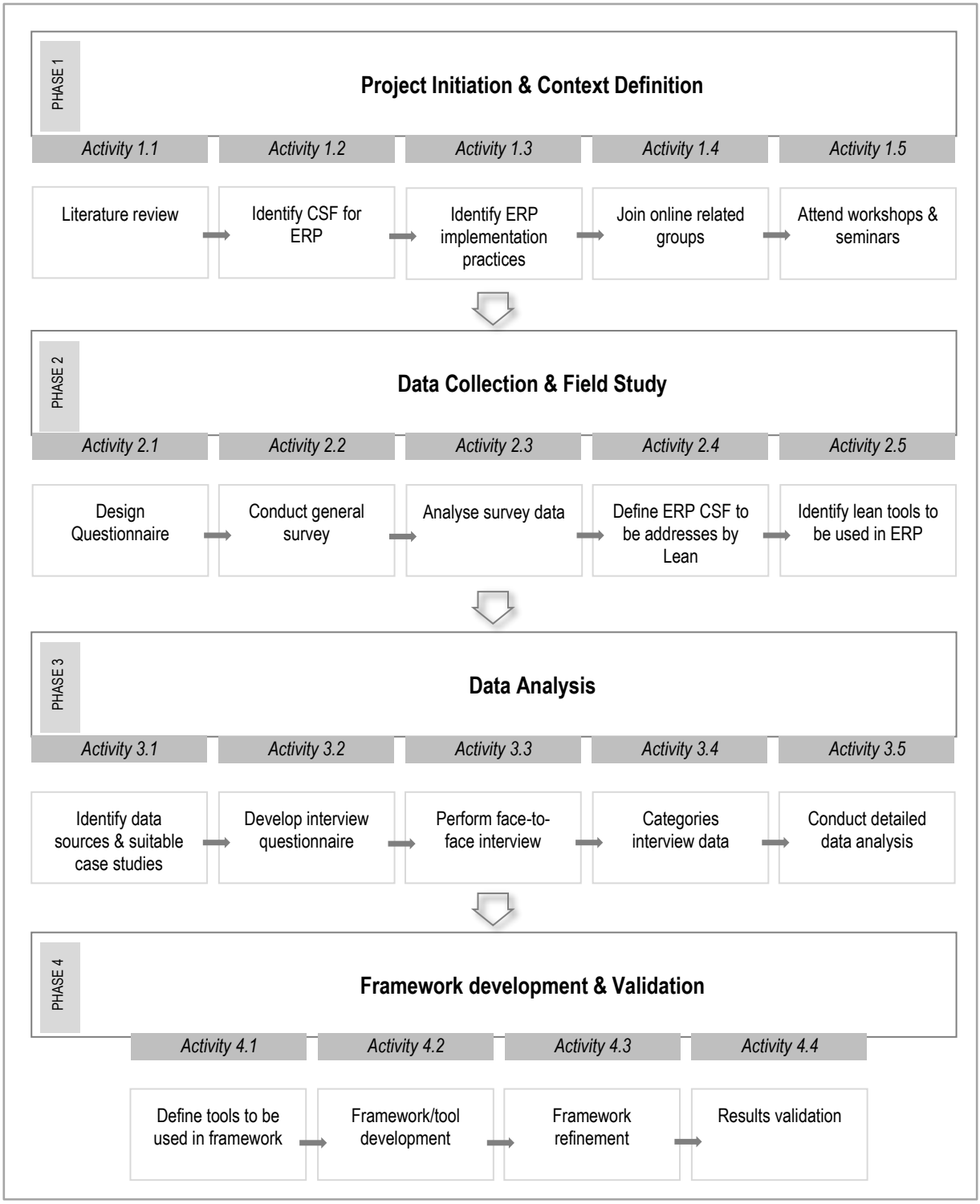


Figure 3-2:Research methodology Structure

3.4 Summary

The research methodology employed during the course of the research in achieving the research aim and objectives has been described in this chapter. Diverse issues linked to the validity of qualitative research were addressed in this chapter, and the strategies to resolve these issues are presented.

Technical explanations of research purpose, design, strategy and data collection techniques have been covered in the first part. The second part of the chapter deals with the adopted research methodology in context of the research, a breakdown of the tasks and objectives in achieving the objectives with details of the tools/methods to be used has been discussed in detail.

The proceeding chapter discusses the current practices in ERP implementation which were identified during the field study with the aid of a semi-structured questionnaire

Chapter 4

CURRENT PRACTICES IN ERP IMPLEMENTATION

4.1 Introduction

This chapter presents the findings from the industrial field study that was conducted with the intent of identifying the current practices and perceptions of industrials practitioners regarding ERP implementation. Section 4.2 of the chapter sets out the purpose of the field study based on the research gaps listed in Chapter 2, details of the field study approach is discussed in detail which gives indication of the methodology adopted by the researcher. A detailed account of the findings of the field study has been presented in Section 4.3, this has been segmented in to two parts; the former investigates the ERP implementation complexity and the possibility of adopting lean type thinking as a means of minimising failures and enhancing the overall ERP implementation process, whilst the latter deals with the initial validation of the lean assessment model. The key challenges of applying lean principles to ERP implementation are listed in Section 4.4. The enablers of leanness assessment are discussed and presented in Section 4.5, the chapter then ceases with a summary in Section 4.6.

4.2 Field Study Approach

During the initial phases of the research an extensive scientific literature review was conducted in Chapter 2. The result of this exercise provided a deeper understanding of the corresponding areas of research including a firm awareness of the current situation which is not just based on mere speculation, rather, supported with evidences from the literature. Section 2.5 clearly lists the current gaps in context of this research, in order to further clarify these findings as well as gain an industrial perspective of the areas of inquiry an industrial field

study was conducted. Table 4-1 identifies three major areas of inquiry in relation to the research gaps which formed the basis of the field study. Having discussed the purpose of the field study and its key areas of investigation, a depiction of the research approach undertaken by the researcher is illustrated in Figure 4-1.

Table 4-1: Major areas of field study inquiry in relation to the research gaps

Literature Review – Research Gaps	Major areas of inquiry for field study
Despite the large number of scientific literature on ERP implementation during the past decades, there is a growing concern regarding the low success of ERP implementation.	Inquiry 1: Identification of industrial perception of ERP implementation process complexity (based on the 9 critical success factors)
The literature on ERP implementation on ERP process improvement has been addressed from multiple perspectives, however there is no discussion on the adoption of lean thinking to minimise the failure rates.	Inquiry 2: extending beyond traditional approaches through the adoption and utilisation of lean type thinking in order to minimise the failure rates of ERP implementation as well as the overall enhancement of the implementation transition through the use of lean principles and tools.
The success of lean principles in non-manufacturing industry is widely discussed, there is some research on the application of lean in IT sector, and nothing has been written on using lean principles and tools in systems implementation.	Inquiry 3: initial validation of the Lean Assessment Tool which is an outcome of the understanding of the literature review.

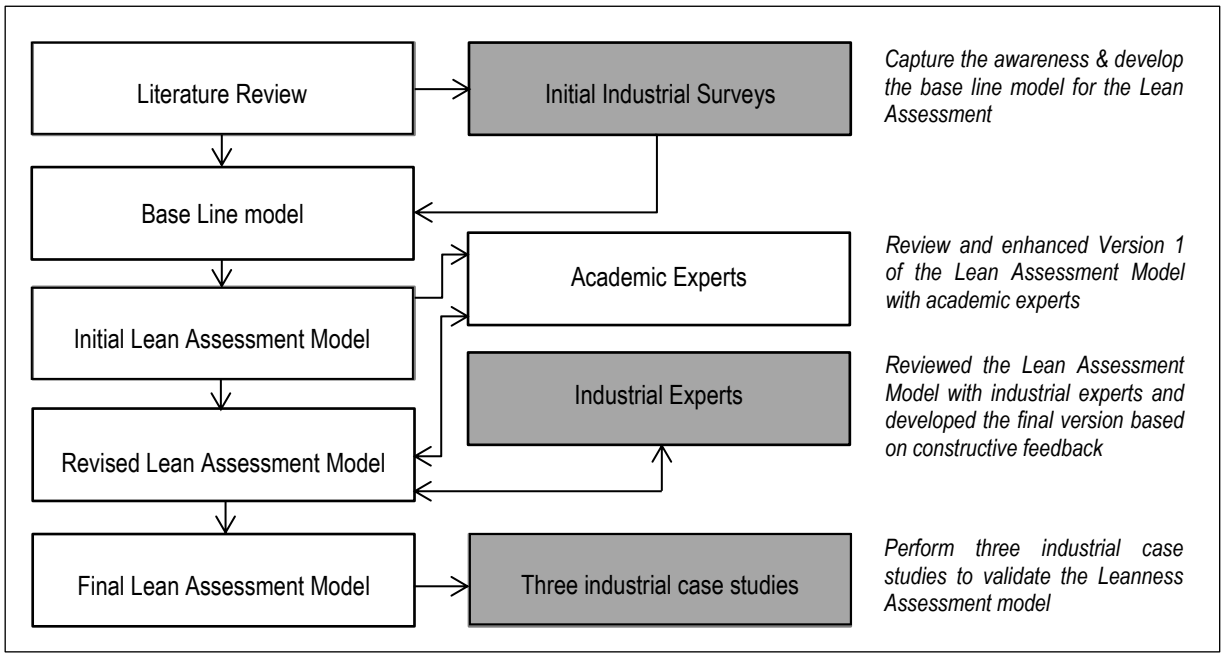


Figure 4-1: Research approach adopted by the researcher during the field study

4.3 Awareness of Lean Principles in ERP Implementation

During the initial phases of the field study a survey was designed and distributed with the main objective of measuring the awareness level of lean principles and tools amongst personal closely associated with ERP implementation projects. To ensure a prevalent sample of findings was obtained, the target audience for the survey consisted of industrial experts from different areas of the globe and a sample was sent to representatives which included consultants, ERP vendors, end users (both IT and business personnel). The most applicable method for data collection for this particular task was the utilisation of web-based surveys, through sending and posting the survey link to email listings, LinkedIn, Twitter and other social networking sites. This approach affirmatively generated a positive response from 66 respondents, the details and results of which are discussed in the proceeding sub sections.

The questionnaire was designed to ensure the overall text was concise and consistent in portraying the message. (See Appendix A) Sufficient explanations were provided to minimise the possible occurrence of ambiguity. In total, 16 questions were generated. The inbuilt features of the web-based survey such as the statistical analysis tools ensured a smooth collation and exportation of the findings through a CSV file in to Microsoft Excel for additional analysis. The findings from the survey are presented in the proceeding sub section.

4.3.1 Survey Results and analysis

The review of the results obtained from the survey are expected to display the overall perception of the respondents with regards to the two areas of inquiry, namely, the perception of ERP implementation process complexity and the identification of relevant lean tools that could be adopted to improve the implementation process. Prior to the analysis of the findings from the survey, it is necessary to provide an insight discussion with regards to the participants, which is discussed in the next section.

4.3.2 Details of respondents

One of the most critical dimensions of conducting any technical field related work is the careful selection of the audience. Figure (4-2) depicts the diverse selection of industrial sectors for the survey. 66.7% of the respondents represent the Telecom, government and consulting businesses, which is a positive indicator because they have a sound understanding and experience of the subject been surveyed, this is further reinstated in Figure (4-3). 90.4% of the respondents are related to ERP projects, they are end-users, consultants or vendors, these findings attest to the right audience for the survey was successfully targeted and selected for the study.

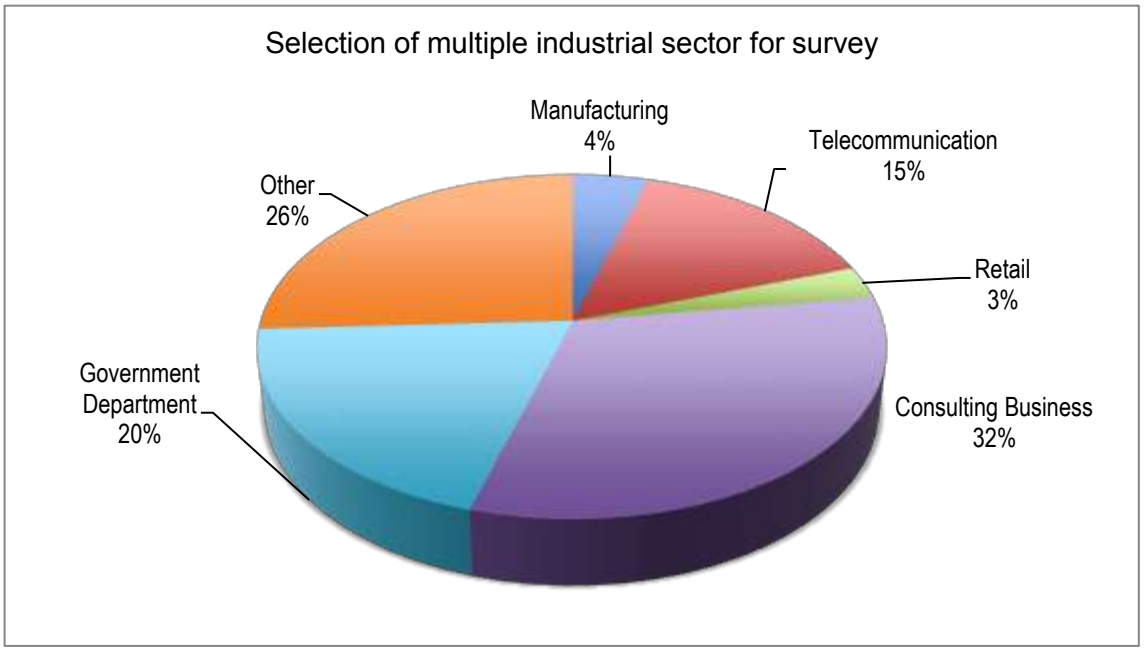


Figure 4-2: Graphical representation of the industrial sectors selected for the survey

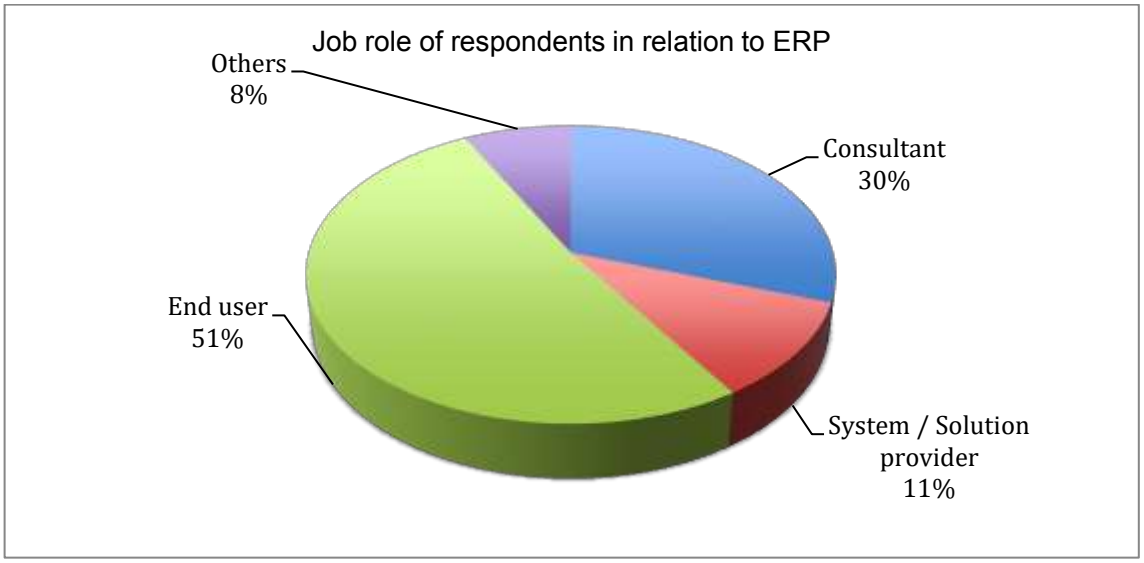


Figure 4-3 : Graphical representation of the job roles of respondents in relation to ERP

Practical experience obtained throughout the years is a valuable resource of information which is favourable option for any technical research being conducted. The resulted depicted in Figure 4-4 highlights that 66.7% of the respondents have 5 years of direct involvement in ERP implementation projects, whilst 27.3% have 15 years or more experience. These results suggest the surveyed audience exceed the minimal threshold of experience with reference to the nature of the investigation and the feedback will be of high value.

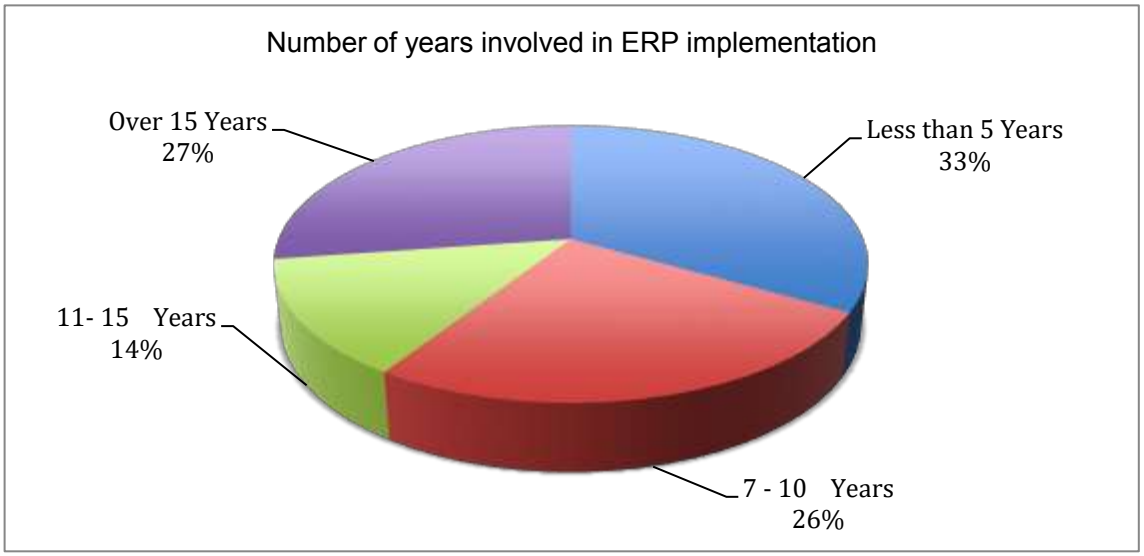


Figure 4-4: Graphical representation of experience in ERP implementation projects

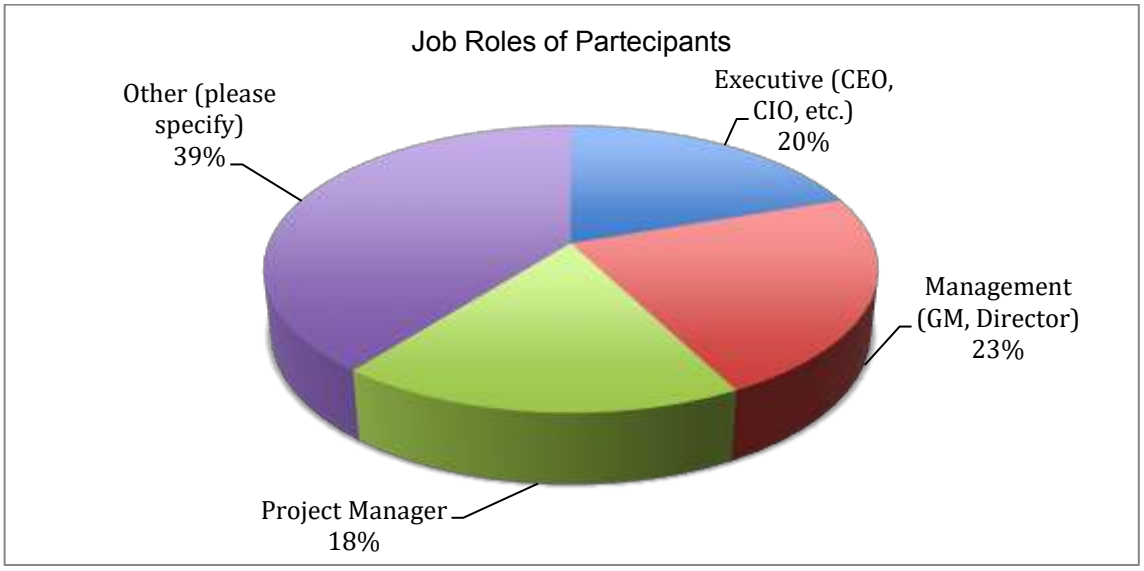


Figure 4-5: Graphical representation of the job roles of participants

The job roles of the participants are shown in Figure 4-5; the numbers reflect a very good ratio for each job group. Having 19.7% participants representing top management group which strengthens the research because some of the critical success factors are solely dependent on the top management, this is explained in the upcoming sections.

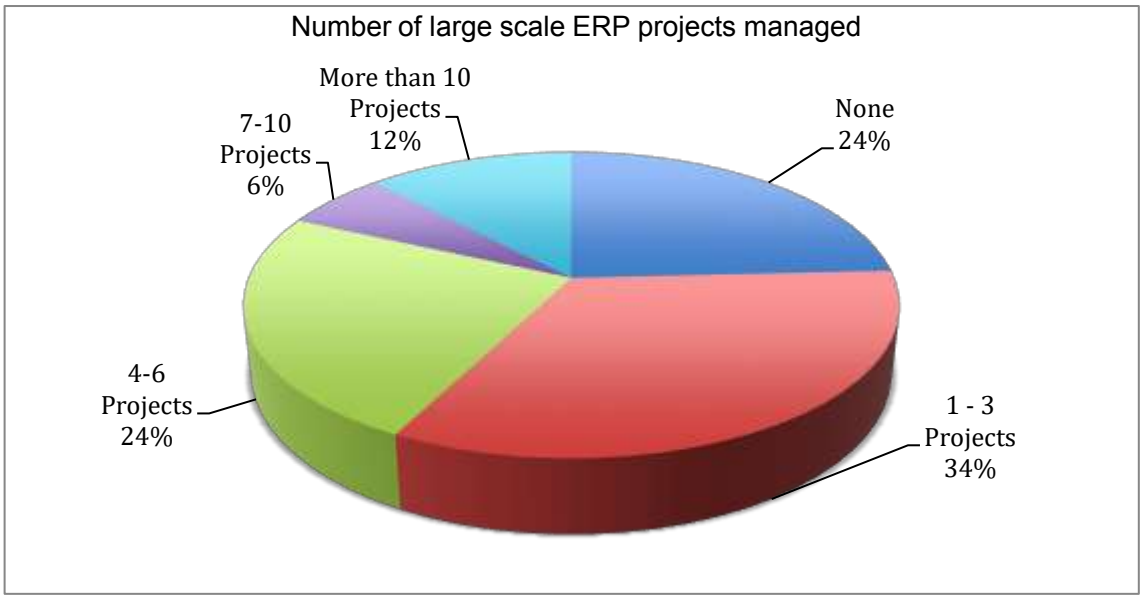


Figure 4-6: Graphical representation of the number of large-scale ERP projects managed by the participants

The results for this section cease with an illustration of the number of large sized ERP projects managed by the respondents. The results from the survey, as indicated in Figure 4-6 suggest that 75.8% of the participants managed large ERP projects with 12.1% having managed more than 10 projects. This fact is self-sufficient in explaining the depth of knowledge possessed by the respondents in ERP implementation projects. The remaining 24.2% of the sample represents the individuals from senior management positions.

This section has provided a detailed account of the respondents selected for the survey, in all the areas that have been covered clearly indicate that the selection made by the researcher is in favour of the research and the results obtained from the survey will be extremely valuable. The proceeding sections will provide a detailed analysis of the three major areas of inquiry discussed in Section 4.2, which has also been enlisted in Table 4-1

4.3.3 Inquiry 1: Perceptions on critical success factors

During the scientific review of literature, critical success factors for ERP implementation were identified (see Section 2.2.3). The formation of the first inquiry rested upon capturing the perception(s) of the respondents with regards to the 9 critical success factors identified by Momoh et al., (2010). The respondents were asked to indicate the *'importance'* of each factor on a Likert scale from 1 to 5, where 5 indicates *'very important'* and 1 as *'not important'*. The results of the inquiry are presented in Figure 4-7 and Table 4-2. All the factors have relatively high rating (above 3.75); "Top Management Support" however scored the highest average rating of 4.64.

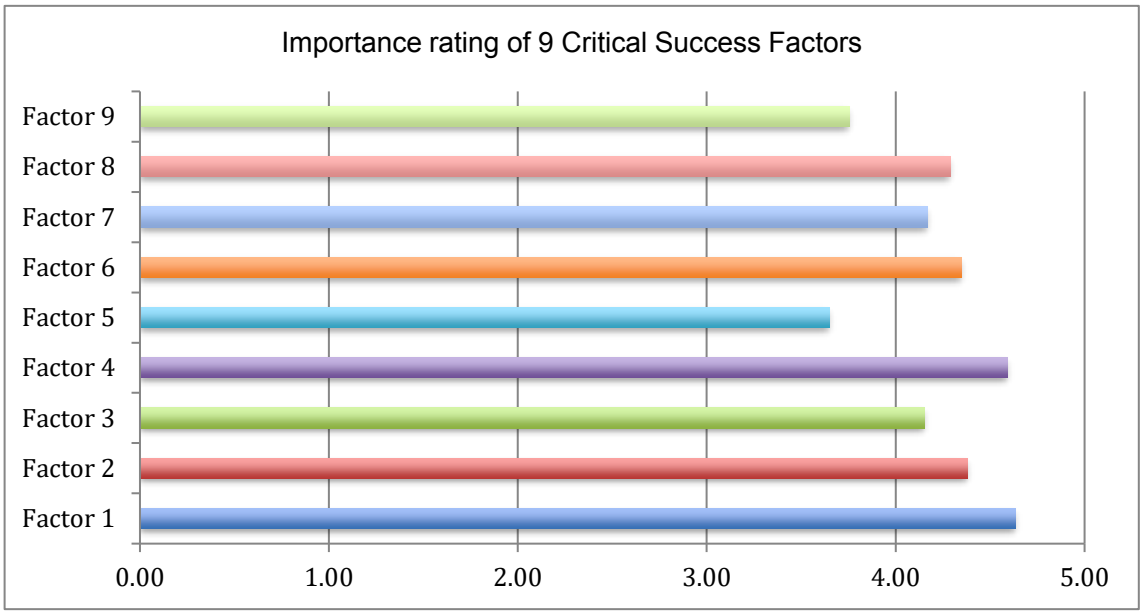


Figure 4-7: Rating of importance for critical success factors

Table 4-2: List of 9 critical success factors and their overall ratings

Factor No.	Descriptions	Rating Average
Factor 1	Top management support to the project.	4.64
Factor 2	Effective change management process.	4.38
Factor 3	Strong internal integration between departments.	4.15
Factor 4	Understanding of business implications and requirements.	4.59
Factor 5	Extent of system customisation.	3.65
Factor 6	The quality of data to be migrated.	4.35
Factor 7	Level and quality of training on system.	4.17
Factor 8	Alignment between IT and business departments.	4.29
Factor 9	Inclusive costs estimate for the project.	3.76

4.3.4 Inquiry 2: Adoption of lean principles/tools for ERP implementation improvements

The results presented in this section are based on the second inquiry of the field study, which is the possibility of adopting lean principles/tools as a means for enhancing the ERP implementation process. The first question that was asked sought to identify the need for the development of a new ERP implementation methodology. The results presented in Figure 4-8 highlight that 87.9% of the respondents are in favour of a new methodology and show a high level of agreement. Drawing reference to the experience and background of the respondents, this fact reflects the high demands for a new methodology that is more effective than the current methodologies being utilised.

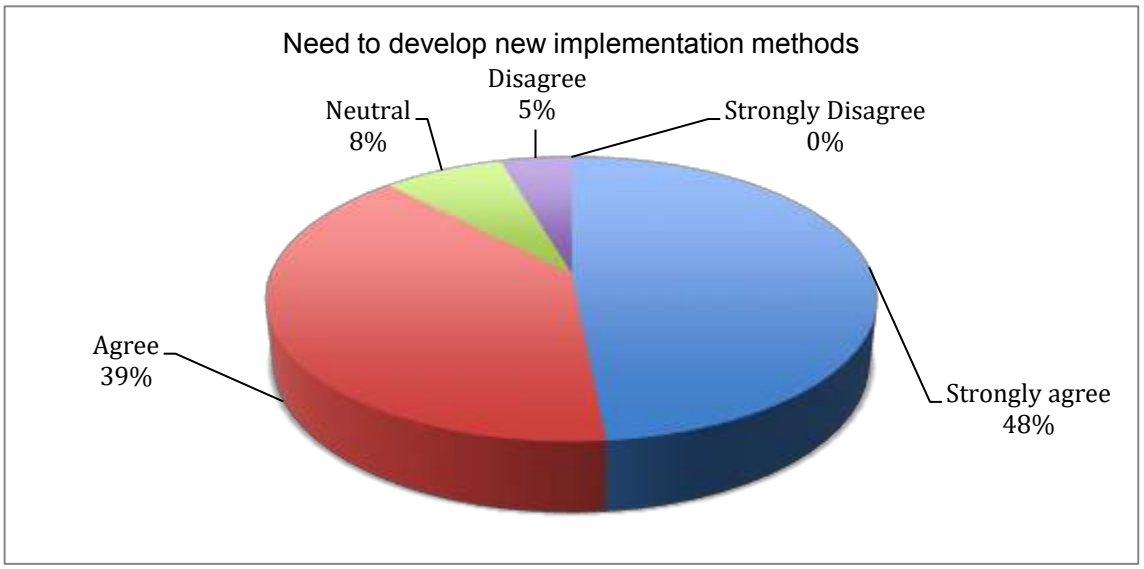


Figure 4-8: The need for a new ERP implementation methodology

The current methods employed in managing ERP implementation are illustrated in the Figure 4-9. All of these methods except, Waterfall and Scrum, are discussed in Chapter 2. The purpose of this question was to form an understanding of the most commonly used methods. As the results suggest 65.2% of the respondents use Project Management methodologies. Agile Methodology is the second most favourable, scoring 39.4% which can be explained as a new methodology which shares similar concepts to lean.

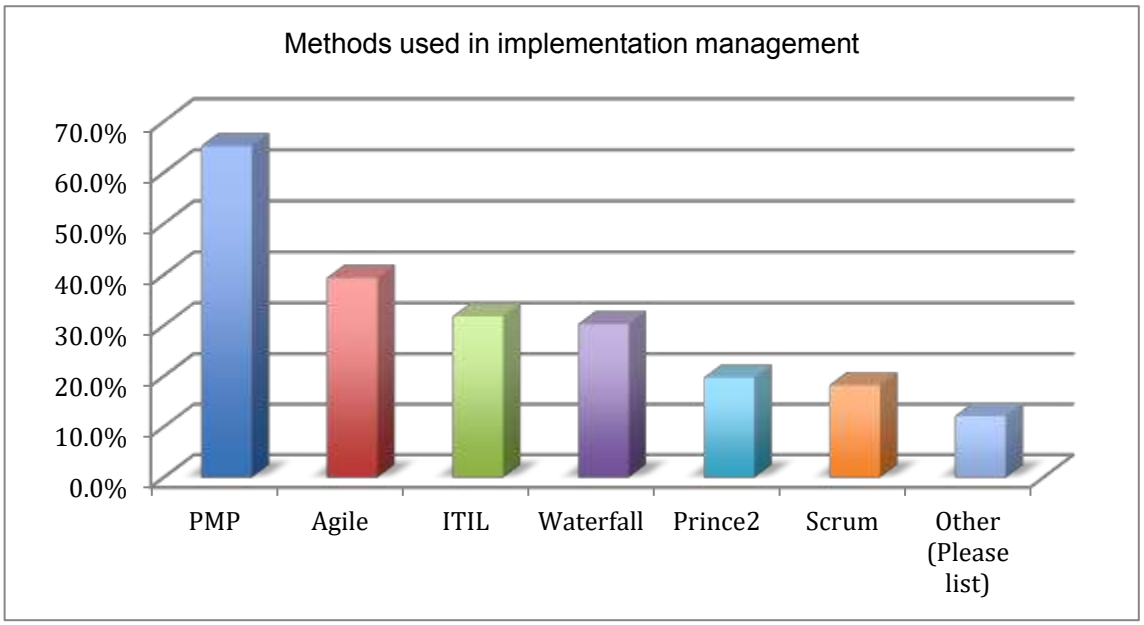


Figure 4-9: Current methods used in implementation management

Prior to forming any judgment regarding the awareness of lean principles in particular its tools and waste, it was necessary to question the respondents regarding this. Figure 4-10 provides an illustration of the results, which clearly highlight VSM and Kaizen are the two well-known tools; scoring 48.5% and 42.4% respectively. These results indicate that there is some awareness of the lean tools as anticipated by the author. Furthermore, some tools are more known than others, as the result of introduction of lean into non-manufacturing industries.

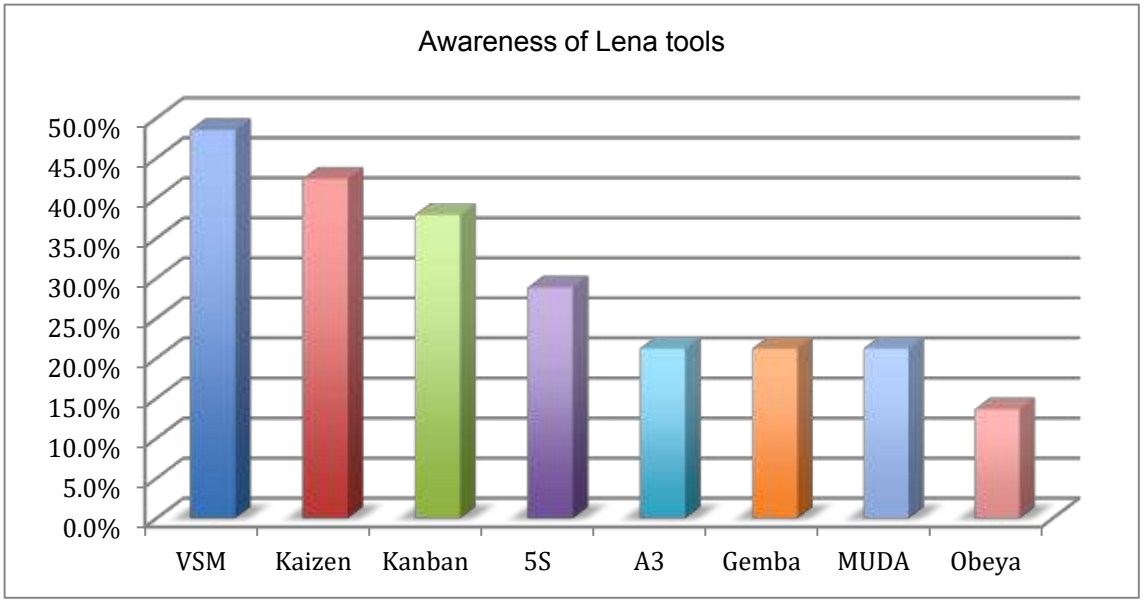


Figure 4-10: Awareness Level of some of lean tools

The participants were asked to state their level of agreement with the following statement: "Usually, there are many iterations and waste of time in all ERP implementation projects that could be eliminated if addressed properly". The result demonstrates that only 6 % disagree with statement and the rest agreed to some level or neutral. Figure 4-11 illustrates the details of the answers.

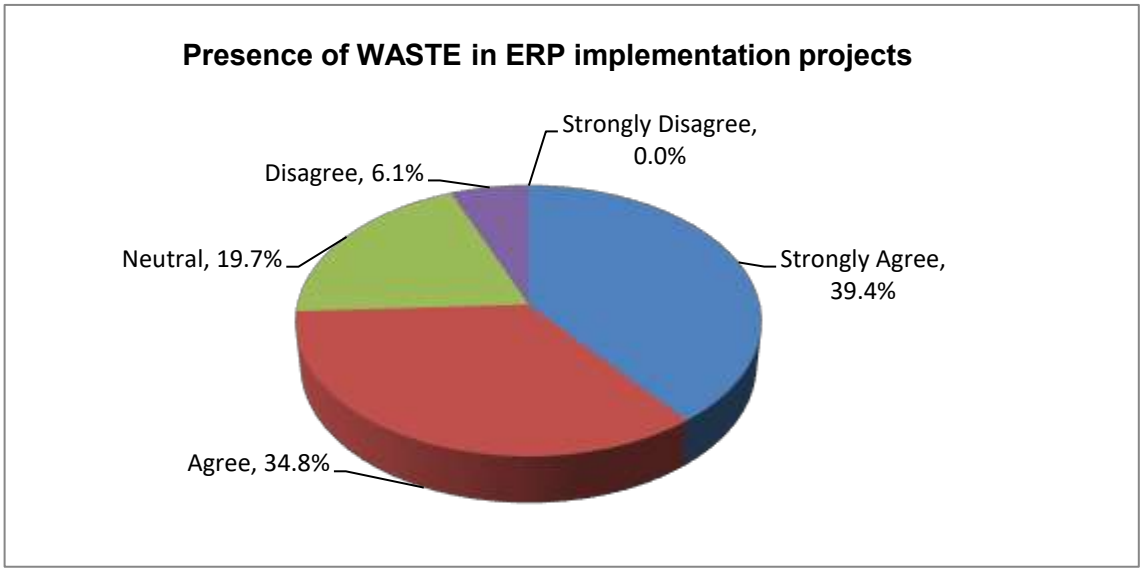


Figure 4-11:Possibility of using lean principles in ERP implementation

In order to further expand on this inquiry, the respondents were asked regarding the possibility of adopting lean principles in to the ERP implementation process. The results are somewhat revealing, which have been presented in Figure 4-12. Between 74.2% of the respondents “agree and strongly agree” regarding the possibility of adopting lean principles for ERP implementation improvement, however a small response of 3% disagreed, this is overweighed by the high number which is in favour of this. The results presented in Figure 4-12 are concerned with adoption of lean principles.

The proceeding investigation sought to advance from this by questioning the usability of lean tools as a means for improving the ERP implementation success rate, the results of which are presented in Figure 4-13. The respondents were given three options on Likert scale for this question which are as follows: Applicable, Maybe Applicable, and Not Applicable.

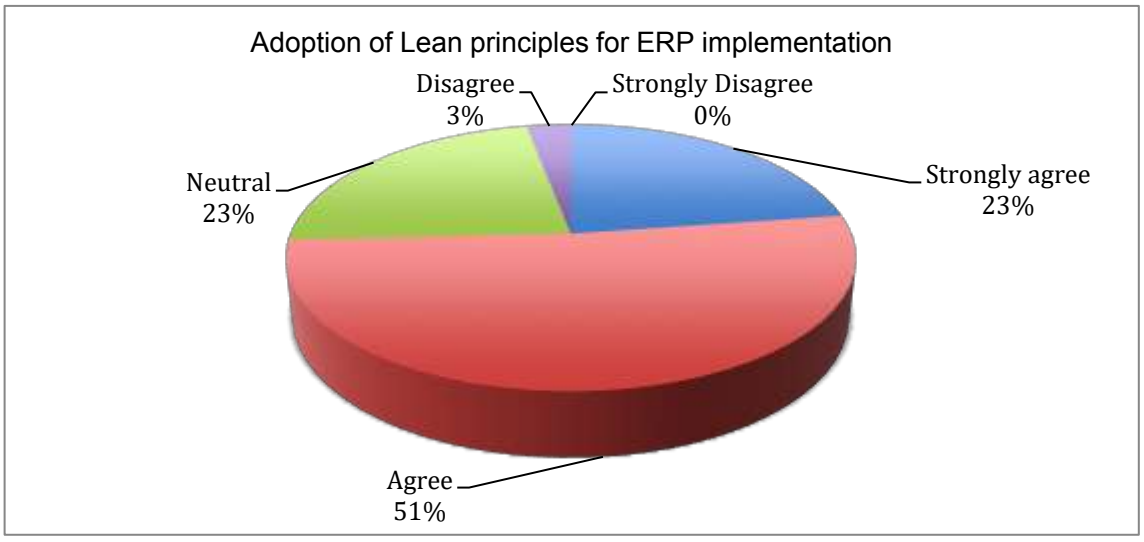


Figure 4-12: Possibility of using lean principles in ERP implementation

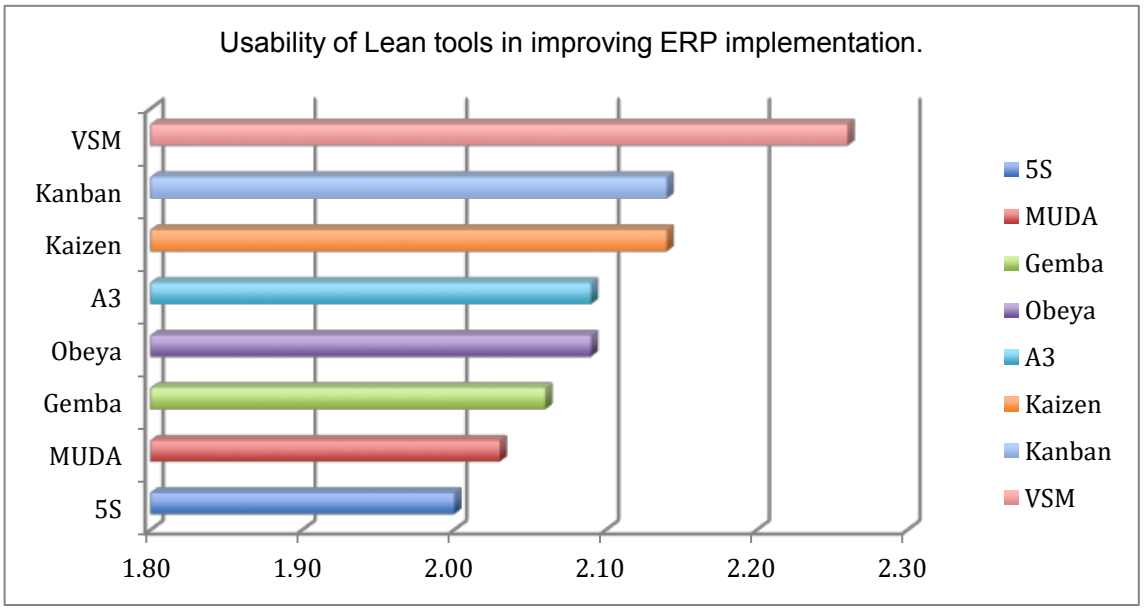


Figure 4-13: Possibility of using lean principles in ERP implementation

The results demonstrate that VSM scored the highest rating of 2.26. Additionally, six out of the eight tools enlisted scored a total rating above 2. However, from the overall review of the responses as highlighted in Figure 4-10 and 4-13, there is a suggestive tendency towards the utilisation of VSM.

The results from the second inquiry conclude at this point and the proceeding section progresses on the final inquiry of the field study, which is directly associated with the initial validation of the Lean Assessment Tool.

4.4 Enablers of Lean ERP Implementation

In ERP implementations, challenges are caused by various risk factors that have been addressed by many researchers as critical success factors (CSFs). Organisations and consultants could utilise the CSFs to assess the readiness of their firm prior to the start of ERP implementation. The assessment is a measurement of the current conditions of the organization which are related to the ERP implementation process. Not only this assessment identifies a firm's current capability to implement an ERP system, but also identifies the areas that are perceived as the organization weaknesses and need improvement to

achieve a better state of readiness for ERP implementation. Thus, potential risks of the project can be reduced and many implementation difficulties can be avoided.

Commonalities between lean transformation and ERP implementation was inferred through the review of scientific literature. Leanness assessment approach found to be applicable to assess the initial readiness of the company prior to any ERP implementation project. These common critical success factors form the basis of identifying the enablers of the leanness assessment model, the researcher started by shortlisting six enablers to be used for leanness assessment model. The enablers have been organised in to the following segments: Leadership & Top Management, Business Process, Employees, Consultancy relationship, Vendors relationship, and Strategic readiness.

The most suitable method for conducting the initial validation of the enablers was through the form of a focus group; with the aid of meetup.com experts related to this field of inquiry were invited for a meeting under the banner of "London Digital Project Managers." A brief description of the project alongside some measures on who could attend the exercise (with a maximum capacity of 25 persons) was posted online, the turnout was overwhelmingly positive and the overall experience was deemed successful. (See Appendix C for invitation details)

The meeting initiated with a short presentation to introduce the project and enlighten the members regarding the research in general. A questionnaire was circulated amongst the participants to record their feedback. (See Appendix D) The 25 experts were all from the IT and business sector with an average of 16 years of work experience. All the participants have project management experience and were more or less acquainted with lean or agile method. The experts were asked to provide their views on all the enablers and criteria and provide a rating for each element from an ERP implementation perspective using a Likert scale. Five options for rating were given for each question, ranging from "Not Important" to "Extremely Important."

As a consequence of the results, additional modifications were made to the initial list which included adding, eliminating, rephrasing certain aspects of the contents of the model. Table 4-3 displays the overall score for the enablers for the options: Important, Very Important and Extremely Important, and based on this result and after careful consideration of the contents the enabler “Strategic Readiness” is omitted from the final version of the model. This approach was adopted for all the criteria and the necessary actions were put in to place in the development of the final leanness assessment model, which will be discussed in detail in the proceeding Chapter. This section ceases with Figure 4-14 that presents the overall graphical representation of the results for the six enablers that reflect how experts perceive them in terms of importance.

Table 4-3: Scoring of enablers for options: Important and Above

Enablers	Score
Strategic Readiness	33%
ERP Vendor Relation	100%
Consultancy Relationship	83%
Business Processes	100%
Top Management Leanness	89%
Workforce Status	100%

4.5 Chapter Summary

This chapter aimed to explore the current industrial practice in ERP implementation field and to assess the status of lean presence in the ERP industry. The findings could be summarised in the following points:

- The critical success factors (CSFs) for ERP implementation are numerous, they are categorised into groups and practitioners provided their perception in ranking these CSFs based on their importance.
- ERP practitioners assert that the growing complexity of the implementations generate a need for new methodologies to successfully manage ERP implementation. Practitioners believe there is a high level of wasted resources in all ERP projects that should be eliminated.

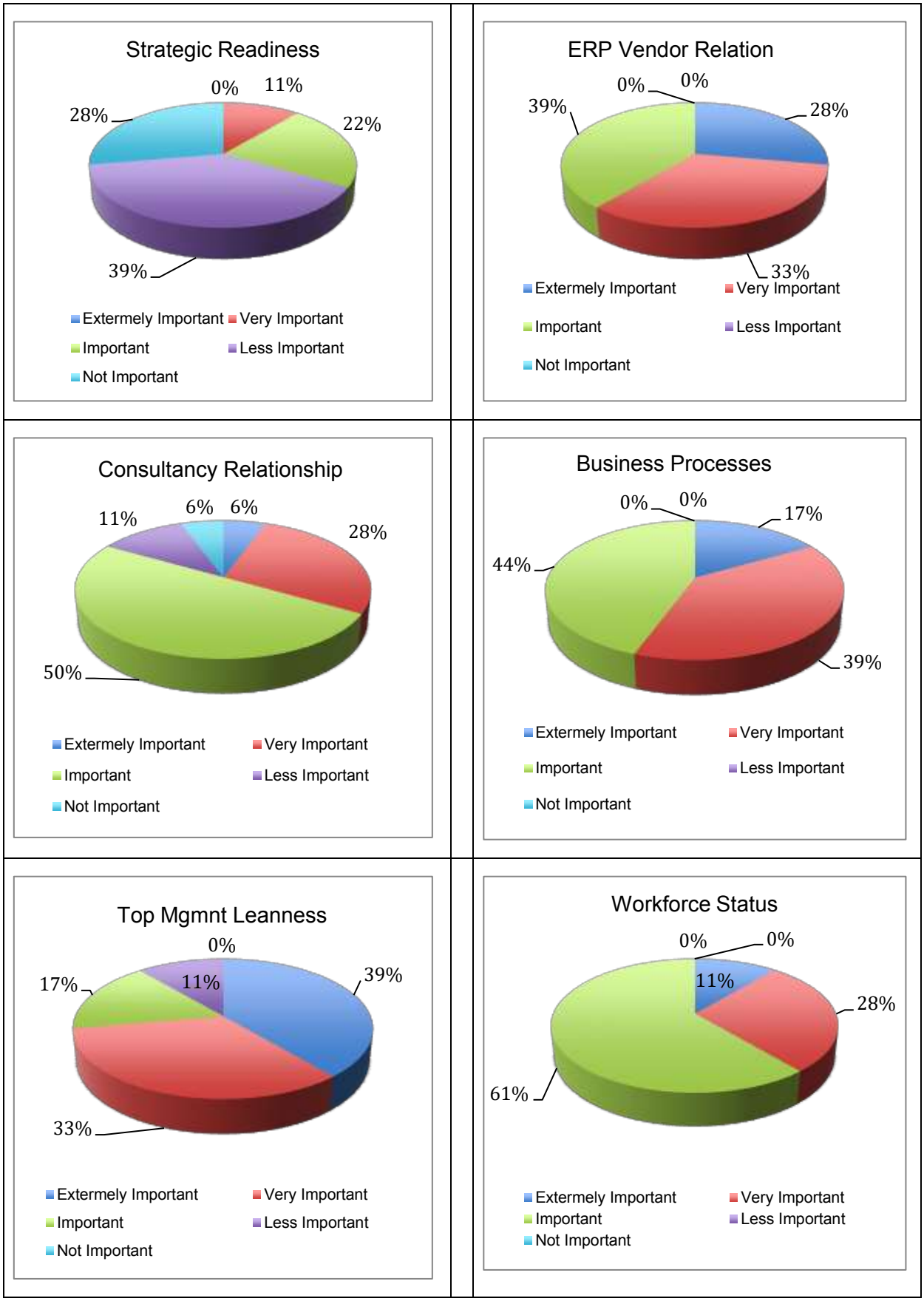


Figure 4-14: Survey for Initial Enablers

- The awareness level of ERP practitioners with lean principles and tools is moderate, which is an acceptable level due to the recent introduction of lean into the IT sector. The participants showed elevated level of knowledge with some of the lean principles and tools such as waste elimination and the use of Kanban boards. Farther investigation exposed that some of the participants know and use the tool but they do not know it is part of the lean tools.
- The challenges and enablers for applying lean principles to ERP projects were identified through iterative process combining literature review and validation with experts from academia and industry

Chapter 5

Lean ERP FRAMEWORK DESIGN AND DEVELOPMENT

5.1 Introduction

This chapter introduces the developed Lean ERP implementation framework and provides a detailed discussion of each component, which is the primary fulfilment of research third and fourth objectives.

As a result of conducting a state of the art scientific review of the literature as recorded in chapter 2, a profound understanding of the essential constituents of ERP implementation and its relevant associative topics was achieved. The understanding was further enhanced through the field study and technical workshops. The need for a leaner approach (to ERP implementation) was justificatory evident from literature, furthermore, industrial practitioners were also seeking advancements in their current methods and endorsed the concept when proposed by the author. In essence, the concept would propose a leaner approach to ERP implementation with the objective of right time, right place, right person and right code of action, seeking to minimise time, cost and waste – whilst ensuring value was realised in an optimal manner. In order to achieve this as well as substantiate the requirements of the third objective, the author followed a progressive method of development. In order to materialise the concept of lean ERP implementation process, the author utilised available knowledge, consultation of experts through regular engagement and collaboration and personal experience (over 20 years of industrial experience of ERP implementation) to achieve the required objectives.

The results showed that no two frameworks are the same, and all of them did not use any lean principles and tools. Some of the frameworks were developed

for a specific brand/vendor such as SAP and Oracle, while others were generic.

The objective of the design and development of a lean based framework is to instigate ERP implementers to incorporate lean thinking throughout the ERP implementation lifecycle. The intended target audience would be; end users, consultants, and vendors of ERP systems.

The framework's scope is to provide clear directions for the activities and tasks required in ERP implementation processes and to direct the implementers to further sources for additional support or study.

The design of the framework started with an extensive literature review and continued with academic and industrial reviews and initial validations. Consecutive assessments of the framework and its tools were conducted through interviews and focus groups with industry experts. Then, an integration of the outcomes led to the development of the final version of the framework. Some of the lean tools and techniques were embedded within the framework such as OBEYA and Value Stream Mapping. The uniqueness of this research is that it combines both the process and causal models while utilizing innovation–diffusion based stage theory to establish a framework for implementation of ERP systems. Figure (5-1) summarizes the stage model and activities as it applies to ERP implementation. The framework is designed with four main components.

1) Leanness / Readiness Assessment Model: Start at the early stage to identify the readiness level of the organisation and help them recognise the areas of improvement.
2) Change Management Model: The implementation of this model should start before the end of the end of the first step; change agents are to be announced.
3) Obeya Room: The setup of this room starts by allocating a space for it and it does not have to be a closed room; long walls would do.
4) Implementation Process: This is where the activities such as system requirements, software development, and data migration take place.

The framework will be presented with guidelines that would provide first hand support on how to use the framework and apply the tools. The framework has been validated with two consultants working in a lean consultancy and their feedback was reflected in the final version of the framework, the result of which will be discussed in Chapter 6.

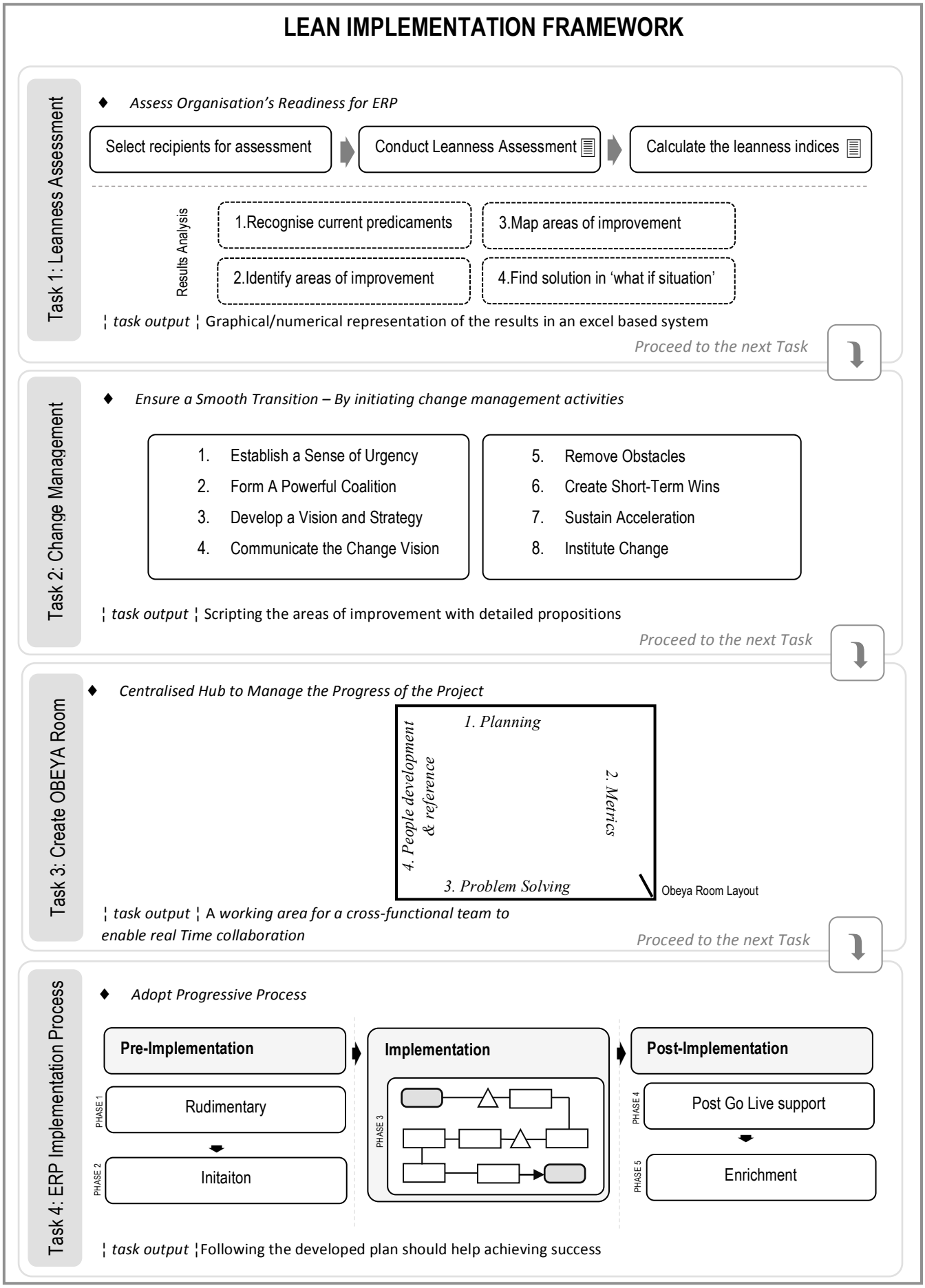


Figure 5.1-1: Framework Structure

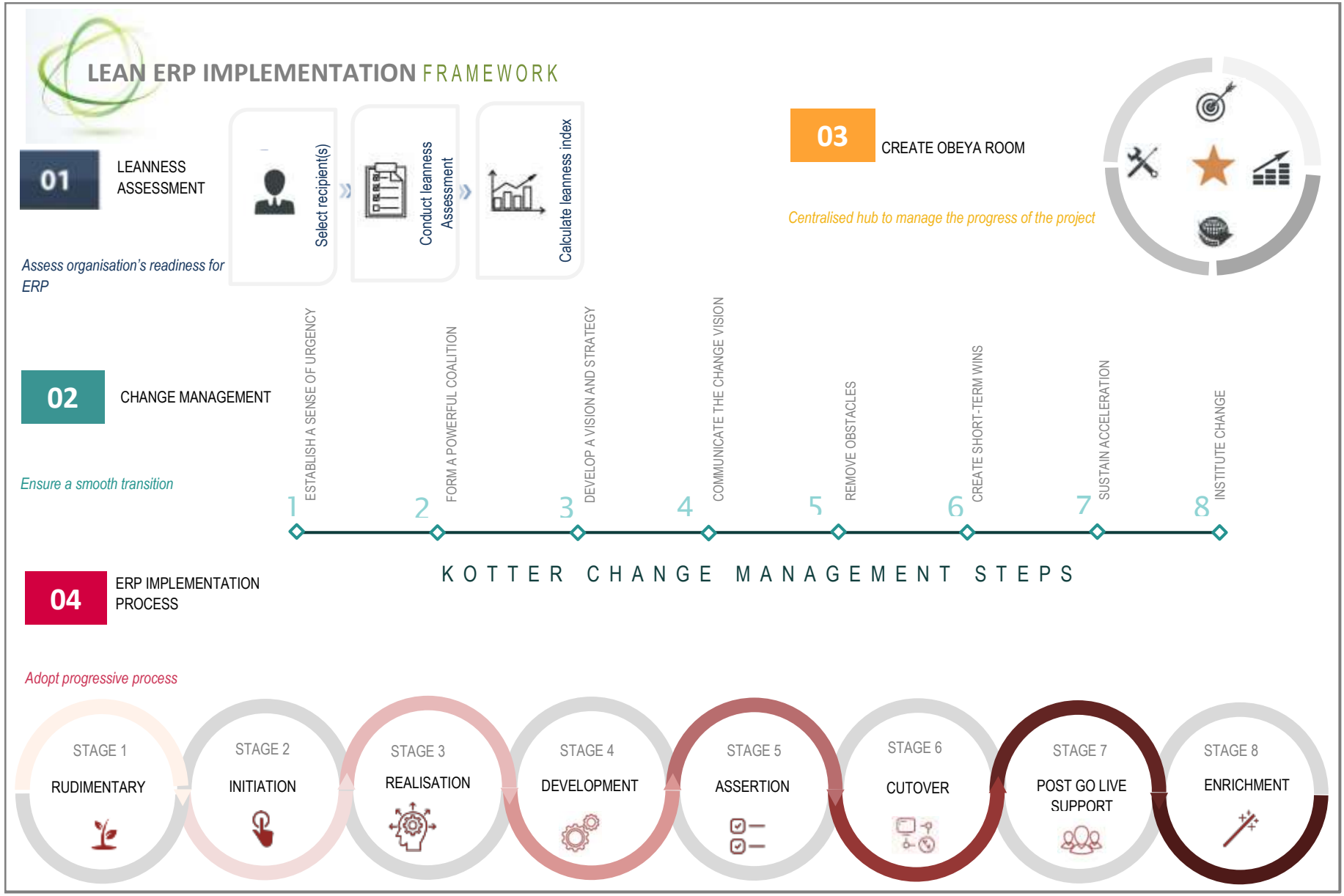


Figure 5.1-2: Overall Framework Elements

5.2 Leanness Assessment Model

The research on the readiness and leanness assessment topic showed that they share resemblances in the concepts and that some of the methods and techniques could be applied to both. Moreover, the surveys of the current practise indicate that lean principles and tools are adaptable to the ERP implementations.

The discussion of this section provides a descriptive overview of the design and development of the model and explains its main component (the enablers). Then, the validation of the model using the developed tool will be highlighted with three case studies. The assessment model helps organisations evaluate their readiness level for ERP implementation and identify underperformance areas, and also enable them to make informed decisions on improvement.

5.2.1 Methodology of Model Development

An iterative process is followed to devolve and validate the leanness assessment model using theoretical and empirical approaches. The first step was an extensive review of the literature on lean thinking in manufacturing and in information technology sectors. And to acquire an understanding of the different options in designing a lean assessment model, the literature review started with two main subjects; Lean transformation assessment and evaluation of ERP implementation processes.

Commonalities between lean transformation and ERP implementation was inferred through the review of scientific literature. These common factors formed the basis of the development of the leanness assessment model, and then the first version of leanness assessment model is developed with three cascading levels in the following structure; six enablers, twenty criteria, and fifty-two attributes.

The first version of the model was reviewed with a number of specialists from academic background and the feedback was reflected on the model. Followed by a focus group and technical workshop with industrial experts involved in ERP

implementation projects. The findings were amalgamated and a revised final version of the model was developed.

The validation of the leanness assessment model has been carried out with three case studies; an international oil and gas company, an international telecom provider company, and a governmental department. For each case, the leanness indices were computed and areas for improvement identified. Finally, the results were presented to the case company for validation and discussion of future action plans. A graphical representation of the methodology has been illustrated in Figure (5-3).

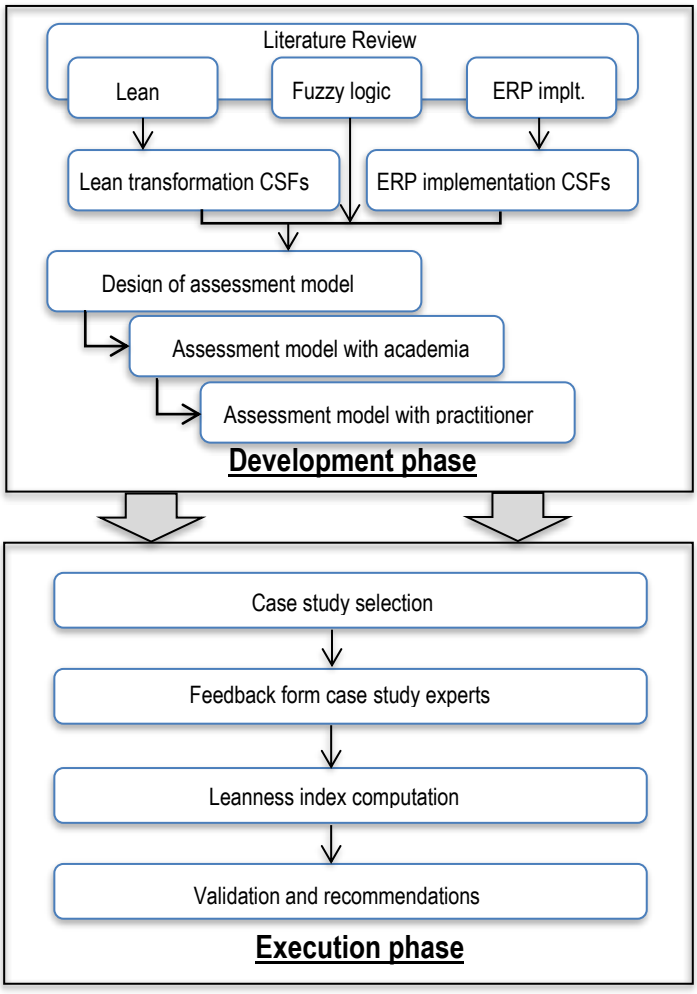


Figure 5.2.1-3: Model Development Methodology

5.2.2 Enablers, Criteria, and Attributes

One of the major contributions of this research is the development of a leanness assessment model; its formation is a result of careful review of scientific literature and collaboration with industrial practitioners well acquainted in this area of research. This section introduces the leanness assessment model and provided a description of its formation including the methods adopted by the author to ensure its wholesome development.

Prior to conducting any type of ERP implementation, it is essential to form an understanding of the status of the enterprise; with this in mind, the leanness assessment model was developed. This would provide essential indicators of the weaknesses and strongholds within the business, and the initial readings from the assessment would allow the implementation team to manage and take necessary actions and precautionary measures according to the results.

The five enablers of the assessment model that were identified in section 4.5 are expanded into two more levels namely criteria and attributes. The rationale behind this expansion is to add more clarity and help the assessors provide more precise feedbacks, which will entail a high level of accuracy in measuring the organisation's readiness. The three levels are organised into (1) enablers, (2) criteria and (3) attributes, as illustrated in Figure (6-2). The primary level has been organised into the following segments: Leadership & Top Management, Business Process, Employees, Consultancy relationship and Vendors relationship.

Figure 5-4 Overview of Model's Elements

Each enabler is further subdivided into 18 criteria at the secondary level. The final level reconstitutes each criterion into attributes which total up to 55. The logical sequence and construction of the model have been illustrated in detail in Table (5-1). A brief description for the five enablers is presented below.

Leadership & Top Management support is a vital enabler for lean transformation initiative and ERP implementation, both initiatives require lots of resources and are time consuming for the organization (Naveen et al. 2013) (Young & Jordan 2008). Top managements are required to show commitment and dedicate time and effort for such initiatives to succeed in their organisations (Suárez-Barraza & Ramis-Pujol 2010). This enabler has three criteria and ten attributes to cover all related aspects and lead to a better assessment.

Business Process: ERP implementation is not only an information technology project; it involves business process reengineering and changes the way companies work. ERP systems are developed with best practices of the industry in mind, and all business processes need to follow processes of the new ERP model. Organisations ought to consider ERP implementation as a change management project to have a successful ERP system (Žabjek et al. 2009). Lean thinking is all about streamlining the process and improving the flow (Womack et al. 2008). This enabler has four criteria and eleven attributes.

Employees: Lean transformation and ERP implementation convey major change to organisations, and the success of these initiatives depends highly on the actions of employees; it is people who drive this change (Dombrowski et al. 2011). It is important to involve employees in the early stages of any major change; this could be achieved through proper communication plan and good training (Bhasin 2012). Lean and ERP implementation usually instigate in organisational restructuring, and this is more likely to result in employees' resistance to change (Momoh et al. 2010). Three criteria and ten attributes are the subdivisions of this enabler.

Consultant Relationship: Major initiatives in corporates or large organisations usually require the involvement of external consultants, and they play a fundamental role in the success of such initiatives (Alhuraish et al. 2014). The quality of the services provided by ERP consultant and the client-consultant relationship is found to be very crucial for the success of the implementation of the system (Lapiedra et al. 2011). The relationships between the consultants, the consulting firm, and the client organization are very complex, however, the preceding literature did not include significant work on the subject (Chang et al. 2013). This enabler has three criteria and ten attributes.

Vendor Relationship: The relationship between the vendor or the supplier and the customer is essential for the success of the project (Mahmood et al. 2013). Organisations are ought to be serious and demanding with vendors in order to assure that vendors are delivering all requirements. Considering vendor's experience, references, and financial state during the selection phase are important factors to the success of the implementation (Pishdad & Haider 2013).

Vendor selection is a very important task and requires cautious attention, organisations need to demand the best possible service from the vendor and make sure that all requirements are fulfilled because the whole project is challenging and big risks are involved (Sarker et al. 2012). Five criteria and sixteen attributes are the subdivisions of this enabler.

5.2.3 Design of Assessment Tool

Having established the concept of the leanness assessment model and its elements, it became sensible to create a practical tool that can be used by assessors and users at the assessed organisations. The researcher started by considering applications such as Microsoft Access or developing a mobile application. However, some of the industry experts and consultants recommended not use these applications because of the limitations of its availability in the case studies.

The leanness assessment tool was developed as an Excel Based System, due to its numerous benefits, which include ease of configuration (for the assessor), ease of usability (for the user), and accessibility as it is a commonly shared platform amongst the different departments of business, the ability to generate statistical reports with graphical data etc. The tool has been tested with a few academics and practitioners for usability and clarity, and the comments were reflected on the final version. At one of the case studies, the researcher discussed the tool with the consultants of the project and they suggested modifying some of the wordings and the sequence of some of the questions to suite the case company. The requirements were done on the spot due to the simplicity of Excel. The researcher also had a chance to observe and analyse some of the documents of the case studies which helped in providing specific examples of how the assessment model can be implemented by that case company. (See Appendix H for example document)

The design of the tool was aiming for a practical and user-friendly application, with clear descriptive information. It starts with an introduction followed by the questions related to three levels; Enablers, Criteria, and Attributes. To farther simplify the process for the participants, a drop-down menu is introduced with all choices where experts can select their preferred answers. There are some conditions in answering most of the questions in the model and to maintain the accuracy of the answers, built in equations are used to show that the conditions are met as well as a cell colour change to make it more visual.

Table 5-1 a: Elements of the assessment model

Enablers	Criteria	Attributes
1. Leadership & Top Management	1.1. Leadership approach	1.1.1. Lean principles supported by top management
		1.1.2. Embracing "leading by example" approach
		1.1.3. True understanding
		1.1.4. Encourage excellent teamwork spirit
	1.2. Management Practice	1.2.1. Smooth information Flow
		1.2.2. Objectives focused
		1.2.3. Good accountability practice
	1.3. Management Culture	1.3.1. Support continuous improvement
		1.3.2. Preventive not reactive approach
		1.3.3. Conscious to cost and waste cutting
2. Business Process	2.1. Clear processes	2.1.1. Clear Documented Processes
		2.1.2. Standardised Processes
		2.1.3. Inclusive Scenarios Business Processes
	2.2. Process Flexibility	2.2.1. Business Processes Change with Conditions
		2.2.2. Ease of Identifying affected Areas in Business
	2.3. Process Streamlining	2.3.1. On Time Delivery
		2.3.2. Adoption of Value Stream Mapping
		2.3.3. Measurable Assessment of Waste
	2.4. Process Improvement	2.4.1. On-going Improvement Team
		2.4.2. Ease of Automation for Business Process
		2.4.2. Availability of Future Business Plans
3. Employees	3.1. Employee status	3.1.1. Good Retention Program
		3.1.2. Clear Roles and Job Descriptions
		3.1.3. Training & knowledge Transfer program
		3.1.4. Team-Work spirit
	3.2. Employee involvement	3.2.1. Strong Participation in Requirements Development
		3.2.2. Delegation and Empowerment for Staff
		3.2.3. Clear and Practical Incentive Program
	3.3. Employee Culture	3.3.1. The constancy of Purpose & Vision
		3.3.2. Innovative & Constructive
		3.3.3. Trust & Collaboration

Table 5-1 b: Elements of the assessment model

Enablers	Criteria	Attributes
4. Consultancy relationship	4.1. Consultancy Experience	4.1.1. ERP Knowledge Insight
		4.1.2. Available expertise/ consultants
		4.1.3. Industry Experience
		4.1.3. Cultural Know how
	4.2. Consultancy Leanness	4.2.1. Experience with Lean philosophy
		4.2.2. Internal Lean Practice
		4.2.3. Previous use of Lean tools in PM
		4.2.4. Value Creation Practice
	4.3. Consultant Development	4.3.1. Lean Knowledge within Team members
		4.3.2. Well-Experienced Staff
		4.3.3. IT and Business Process expertise
5. Vendor Relationship	5.1. Vendor Leanness	5.1.1. Adoption level of Lean Principles
		5.1.2. Existence of Clear Processes
		5.1.3. Culture of Continuous Improvement
	5.2. Vendor Quality	5.2.1. Technological Competence
		5.2.2. Diverse Customer Base
		5.2.3. Range of customisation
	5.3. Direct / partner	5.3.1. Level of Partnership
		5.3.2. Conflict of interest
		5.3.3. Clear relationship
	5.4. Vendor Support	5.4.1. Clear Upgrade Plan
		5.4.2. Degree of Commitment
		5.4.3. Available Support Levels
		5.4.4. Proximity
	5.5. Vendor Development	5.5.1. Regular Training Programs for staff
		5.5.2. Attention to Market / Industry Needs
		5.5.3. Adoption of Continuous Development

The tool has five sequential steps where each step is on a separate sheet of the file, and users need to click an icon on each sheet to move to the next one.

The basic setup at each case study is to have the group of experts in one room where the researcher delivers a presentation explaining the objectives and techniques, and after the introduction experts start to populate the Excel file individually. Having explained the purpose of the model, descriptive visuals of the key areas of the tool have been provided for the reader.

The opening page of the leanness assessment model provides a brief background for the recipient, which includes the aim of the model and what it involves as shown in Figure (5-5).

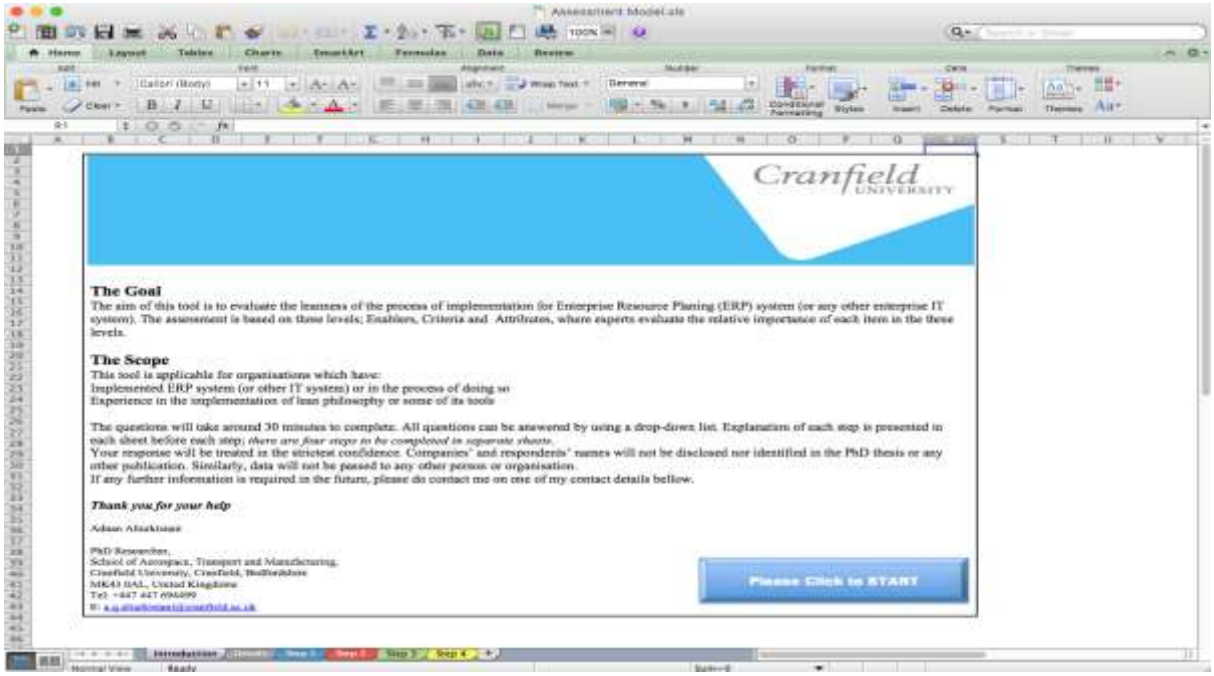


Figure 5-5: Main page of Leanness Assessment Model

A user is prompted to proceed on to the next page in which they are required to record their details in a predesigned template, as shown in Figure 5-6. The captured information in this screen is of a demographic nature to help in validating the quality of data if needed.

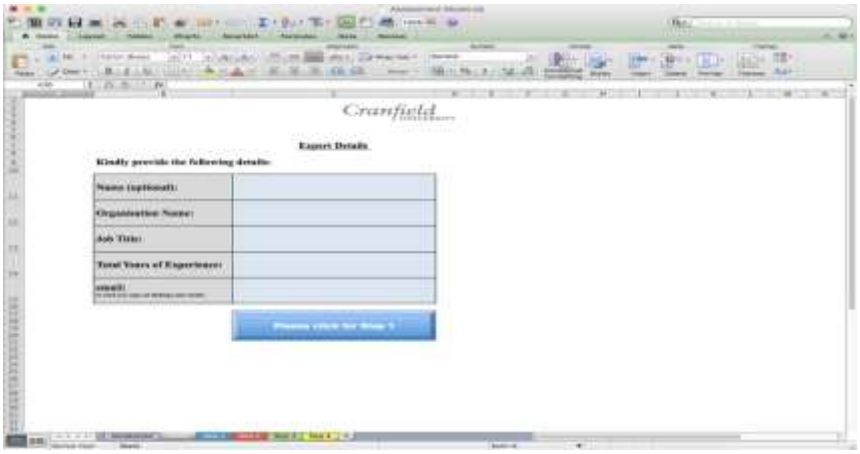


Figure 5-6: Recording details of the expert

The next step is the start of the evaluation process of the elements in the tool. Based on personal experience and judgement the experts are required to provide a relative ranking for the predefined enablers which have been listed, each ranking is based on a percentage as illustrated in Figure (5-7). The question asks the experts to provide their opinions on the importance of each enabler by distributing 100% over the five enablers.

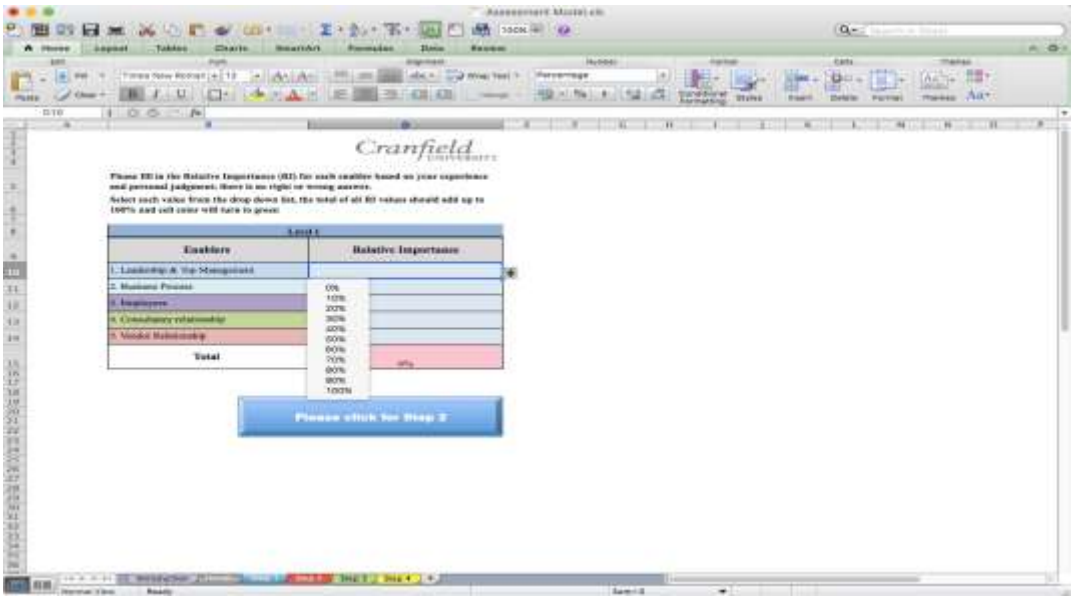


Figure 5-7: Relative importance ranking for Enablers page

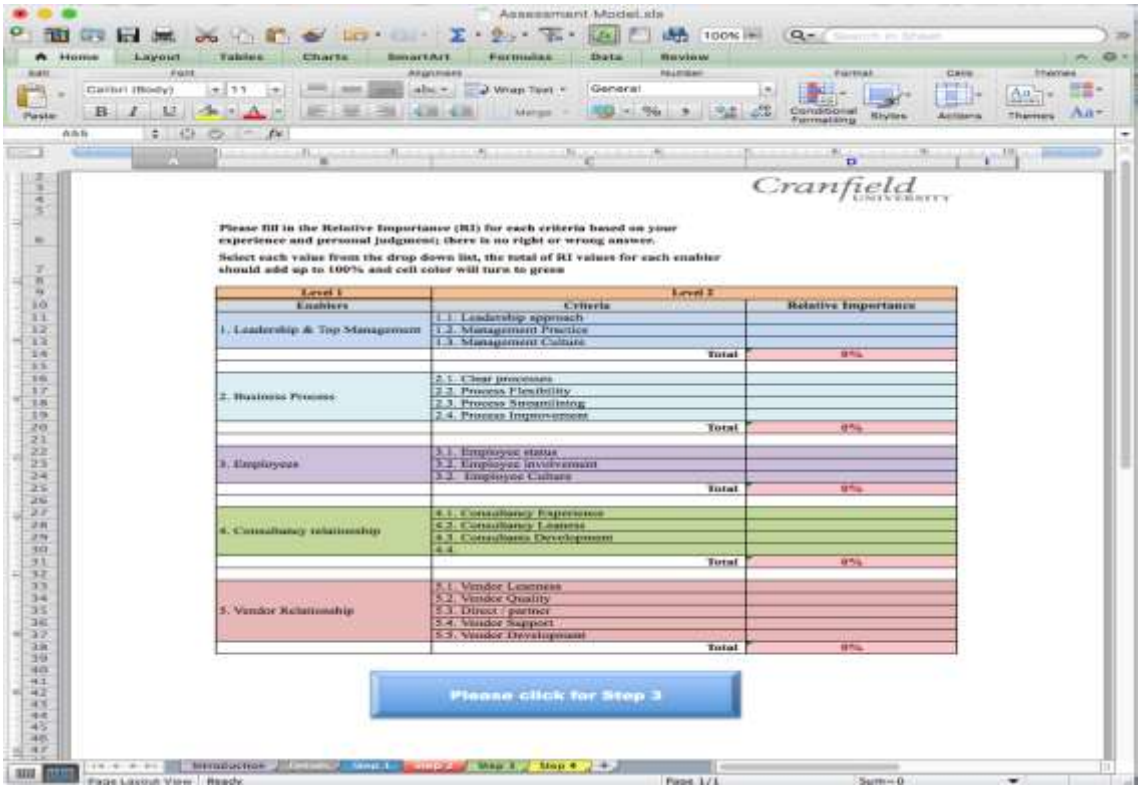


Figure 5-8: Relative importance ranking for Level 2 (Criteria)

In continuation, the user is further required to assess the criteria and provide a relative ranking. It is noteworthy to state each criterion directly corresponds to each enabler (see Figure 5-8). The user is then required to progress on to Level 3, at this stage a relative ranking for each attribute (that corresponds to the previously assessed criteria) is required, this has been depicted in Figure (5-9).

The final task of the assessment requires the users to provide the actual rating for each attribute as opposed to the providing a relative ranking which was done in the previous task. The purpose of this is to capture the current levels of presence in the organisation of each criterion. For these tasks users will not provide a percentage, they are required to provide a ranking from 0-10 as shown in Figure (5-10). The tool thereafter generates a leanness index from the assessment which can be viewed within the excel system.

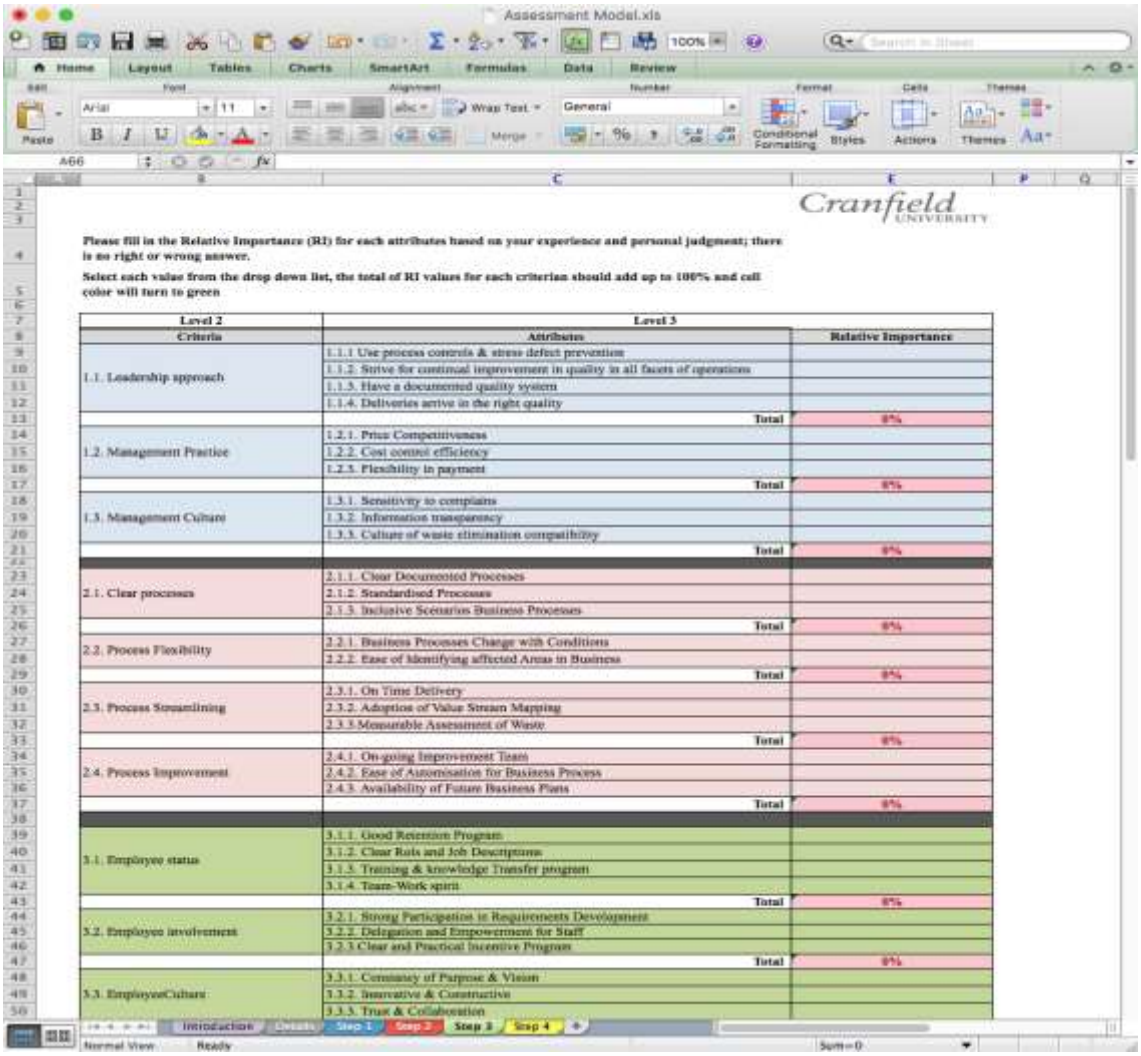


Figure 5-9: Relative importance ranking for Level 3 (Attributes)

It is deemed essential to provide a basic overview of the essentials prior to presenting the findings from the case studies to enhance the readers understanding. The approach adopted in the development of the leanness model is based on the works of Vinodh and Chintha (2011) with certain alterations to suit the nature of the research. The leanness index (I) is calculated by multiplying the overall assessment factor (R) and the overall weight (W).

$$Leanness\ index\ (I) = W \times R$$

Fuzzy numbers model the vagueness of subjective humans' judgment on the degree of application of lean practices; five sets of fuzzy numbers are used to represent the scores of leanness assessment as follows:

- (8-10) Stands for 'Remarkably Lean'
- (6-8) Stands for 'Highly Lean'
- (4-6) Stands for 'Normally Lean'
- (2-4) Stands for 'Not Lean'
- (0-2) Stands for 'Extremely Not Lean'

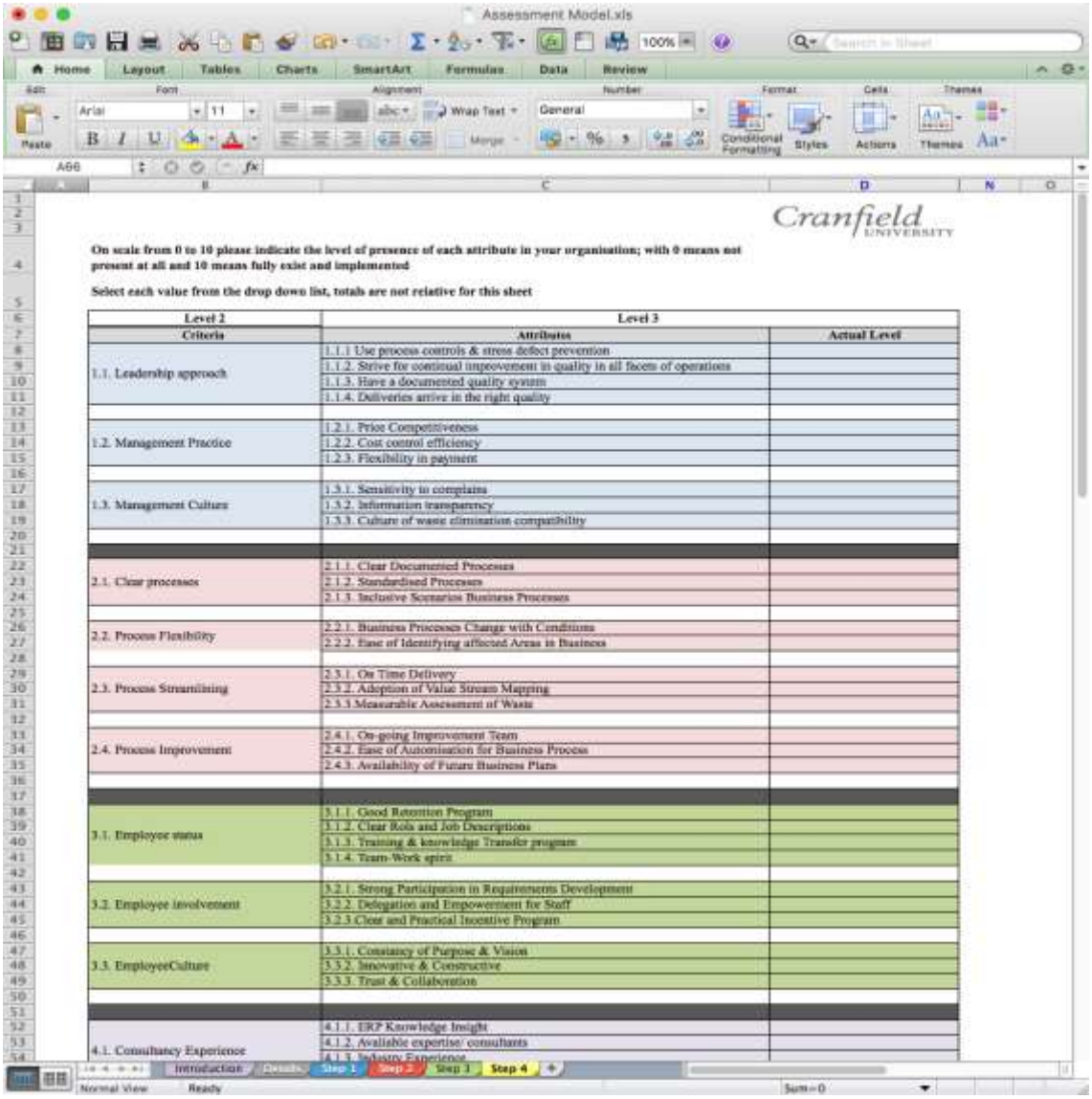


Figure 5-10: Actual rating for Level 3 (Attributes)

5.2.4 Case studies

In order to establish a substantial understanding of the As-IS ERP Implementation process, as well as gain sound insight in to the undermining root causes for implementation failures, a qualitative method for the inquiry was employed. Intentionally, the purpose of this activity was to aid in the identification of a final set of critical success factors which would be addressed by lean tools which will be housed in the final conceptual framework. This section discusses the approach adopted by the author in conducting the inquiry with specific details of the corresponding organisations used as case studies. Following a brief background of the companies, a detailed presentation of the results obtained from the case studies is presented followed by an amalgamation of results which help in drawing certain conclusions. Several organisations where contacted by the researcher from the European and Middle East countries, requesting participation to which three organisations expressed high levels of interest. For confidentiality reasons, the case studies will be labelled as case A, case B, and case C.

5.2.4.1 Case Study (A):

Company A is one of the oldest international oil and gas company. It is currently operating in 70 countries worldwide and has an estimate of 94000 employees from diverse backgrounds. In 2014, they reached a production mark of 3.1 million barrels of daily oil production and were able to generate $421.1 billion revenue, of which $1.2 billion US dollars is assigned for R&D Investment. Case A operations are divided in to the following five businesses: Upstream, Integrated Gas, Unconventional Resources, Downstream and Projects & Technology. Lean thinking is fairly a new initiative in the company which started 10 years ago, however, it has only been within the last four years before it was introduced to its IT sector.

The case study initiates with calculating the relative importance weight (W) for each enabler, criterion, and attribute, and then the median of experts' data is computed for each element. The reason why the median has been selected over the mean is that the data reflects the personal impressions of few experts

which makes it difficult to anticipate the symmetry of data distribution. Median is a better measure of the centralised figure, which is regarded as a sound representative of the distribution of the measurements. The actual assessment figures provided by each expert and the relative importance weights for all enablers, criteria, and attributes have been presented in Table (6-2).

In continuation, the second step is to calculate the index of each criterion; an example for this step is given by the calculation of the index for "Leadership Approach" criterion, which is as follows: Weights pertaining to the leadership approach criterion W_{11}=(0. 3, 0.3, 0.1, 0.4). Assessment scores pertaining to the leadership approach criterion is given by:

$$R_{11}=\begin{bmatrix}7 & 8 & 6 & 9 & 8\\ 9 & 8 & 7 & 8 & 6\\ 7 & 9 & 6 & 8 & 8\\ 8 & 7 & 8 & 7 & 9\end{bmatrix}$$

Index pertaining to the leadership approach criterion is given by

$$I_{11}=W_{11}\times R_{11}$$

$$I_{11}= (8.7, 8.5, 7.7, 8.7, 8.6)$$

The indices relating to the other criteria have been computed using the same techniques, Table (5-3) present the calculated indices.

The third step is the calculation of the indices belonging to each enabler; an example for this is given by the calculation of the index for the "Leadership and Top Management" enabler, which is given by: $I_1=W_1\times R_1$

Weight pertaining to the leadership & top management enabler is given by:

$$W_1= (0.30, 0.30, 0.40)$$

Table 5-2: Experts assessment score and weights for Case A

E1	E2	E3	E4	E5	W_{ij}	W_i	W		I_{ij}	I_i
7	8	6	9	8	0.3					
9	8	7	8	6	0.3					
7	9	6	8	8	0.1	**0.3**			I_{11}	
8	7	8	7	9	0.4					
9	8	7	8	6	0.5		**0.4**			I_1
8	7	7	7	7	0.3	**0.3**			I_{12}	
8	9	7	7	6	0.2					
7	8	8	8	9	0.3					
7	9	7	9	9	0.4	**0.4**			I_{13}	
8	8	8	7	6	0.3					
8	9	8	7	8	0.3					
9	8	8	8	9	0.5	**0.3**			I_{21}	
8	8	7	5	7	0.2					
7	7	8	9	8	0.5	**0.3**			I_{22}	
8	8	7	7	6	0.5					
9	7	8	7	6	0.5		**0.2**			I_2
7	9	6	9	9	0.2	**0.2**			I_{23}	
6	8	5	8	9	0.3					
8	9	7	8	9	0.3					
7	6	9	5	7	0.3	**0.2**			I_{24}	
8	8	8	9	9	0.2					
9	8	8	9	7	0.1					
9	7	9	7	9	0.4	**0.4**			I_{31}	
7	9	9	7	9	0.3					
9	8	6	8	8	0.2					
8	8	8	7	9	0.5		**0.2**			I_3
8	9	7	8	8	0.3	**0.3**			I_{32}	
9	8	9	8	8	0.2					
8	7	7	9	9	0.5					
5	8	8	8	7	0.3	**0.3**			I_{33}	
7	8	8	8	8	0.3					
7	8	8	8	9	0.3					
8	9	8	6	8	0.3	**0.6**			I_{41}	
8	8	8	9	9	0.3					
8	7	7	5	7	0.2					
8	9	8	9	9	0.4		**0.1**			I_4
6	7	7	7	8	0.1	**0.2**			I_{42}	
7	8	9	7	8	0.3					
8	9	7	8	7	0.2					
8	8	8	9	9	0.3					
9	9	8	9	9	0.4	**0.2**			I_{43}	
9	8	9	8	8	0.3					
8	8	7	9	8	0.4					
7	9	7	8	9	0.4	**0.1**			I_{51}	
6	8	8	7	7	0.3					
7	8	8	8	7	0.5					
9	9	9	9	9	0.2	**0.3**			I_{52}	
9	8	9	9	9	0.3					
9	7	9	8	8	0.4					
7	8	8	9	6	0.3	**0.2**	**0.1**		I_{53}	I_5
8	7	7	6	8	0.4					
9	9	8	7	8	0.2					
8	8	9	9	8	0.4	**0.3**			I_{54}	
9	7	7	8	8	0.3					
8	8	9	8	9	0.1					
7	9	7	8	9	0.3					
9	7	9	7	6	0.4	**0.2**			I_{55}	
7	8	7	7	7	0.4					

Table 5-3 Calculated indices for all criteria (per expert) for Case A

	E1	E2	E3	E4	E5
I_{11}	8.7	8.5	7.7	8.7	8.6
I_{12}	8.5	7.9	7.0	7.5	6.3
I_{13}	7.3	8.4	7.6	8.1	8.1
I_{21}	8.5	8.3	7.8	7.1	8.3
I_{22}	7.5	7.5	7.5	8.0	7.0
I_{23}	7.7	7.7	6.7	7.7	7.5
I_{24}	6.1	6.1	6.4	5.7	6.6
I_{31}	8.4	7.9	8.3	7.4	8.6
I_{32}	8.2	8.3	7.9	7.5	8.5
I_{33}	7.6	8.3	8.3	9.3	9.0
I_{41}	8.5	8.9	8.6	7.9	9.2
I_{42}	7.5	8.5	8.0	8.0	8.2
I_{43}	8.7	8.4	8.3	8.7	8.7
I_{51}	7.8	9.2	8.0	8.9	8.9
I_{52}	8.0	8.2	8.5	8.5	8.0
I_{53}	8.9	8.0	8.8	8.3	8.2
I_{54}	8.5	7.9	8.2	8.2	8.1
I_{55}	8.5	8.7	8.5	8.0	7.9

Key: E= expert

Assessment scores pertaining to the leadership & top management enabler is given by:

$$R_1=\begin{bmatrix}8.7 & 8.5 & 7.7 & 8.7 & 8.6\\ 8.7 & 7.9 & 7.0 & 7.5 & 6.3\\ 7.3 & 8.4 & 7.6 & 8.1 & 8.1\end{bmatrix}$$

Index pertaining to the supplier relationship enabler is given by:

$$I_1=W_1\times R_1$$

$$I_1=(8.1, 8.3, 7.5, 8.1, 7.7)$$

Using the same principle, the following indices have been calculated for remaining lean enablers as shown in Table (5-4).

Table 5-4 Calculated indices for all enablers (per expert) for Case A

	E1	E2	E3	E4	E5
I_1	8.1	8.3	7.5	8.1	7.7
I_2	7.6	7.5	7.2	7.2	7.4
I_3	8.1	8.1	8.2	8.0	8.7
I_4	8.3	8.7	8.4	8.1	8.9
I_5	9.2	9.1	9.3	9.2	8.9

Key: E= expert

The fourth and final step is computing leanness index for ERP implementation process in Case A company, which is done as follow:

Overall weight: W= (0.40, 0.20, 0.20, 0.10, 0.10) **Error! Digit expected.**

$$R=\begin{bmatrix} 8.1 & 8.3 & 7.5 & 8.1 & 7.7 \\ 7.6 & 7.5 & 7.2 & 7.2 & 7.4 \\ 8.1 & 8.1 & 8.2 & 8.0 & 8.7 \\ 8.3 & 8.7 & 8.4 & 8.1 & 8.9 \\ 9.2 & 9.1 & 9.3 & 9.2 & 8.9 \end{bmatrix}$$

Process leanness value: I= WxR

I= (8.1, 8.2, 7.8, 8.0, 8.1)

I= 8.1

Based on the results generated from the assessment tool, the leanness index for ERP implementation process in Case A is 8.1, which is “Remarkably Lean”. Although the company started implementing lean for ten years, this level is acceptable considering the fact that the company started using lean in the IT sector for the past four years only. However, these results indicate that there is

a room for further improvement and enhancement, specifically in the IT sector of the company and its processes.

The index values and relative importance weight for the enablers are shown in Table (5-5); it revealed that the most important enabler is “Leadership and Top Management” based on the weight value. The remaining enablers are ranked in the order: Business Process, Employees, Consultant Relationship, and Vendor relationship. The table also shows that the “Business Process” enabler has the least leanness index with a relatively high weight; it is therefore recommended that improvement should be started herewith.

Table 5-5 Consolidated indices & weight for enablers

Enabler	Index	Weight
Leadership & Top Management	7.9	0.4
Business Process	7.4	0.2
Employees	8.2	0.2
Consultant relationship	8.5	0.1
Vendor Relationship	9.1	0.1

5.2.4.2 Case Study (B):

This case is the largest company in Saudi Arabia that provides all range of telecom services (mobile, fixed, data and TV services), it was initially a government department before it was privatised and is now currently operating independently within the public domain, since 1998. Case B has currently operated in other regions within the Arabian Gulf Region such as Kuwait and Bahrain. In addition to Turkey and Indonesia, and their total number of employees in Saudi Arabia is over 24000. Recently they finished a large implementation which includes ERP, CRM, and Billing Systems. The company started implementing lean thinking in its information technology department during the last quarter of 2013 with the intention to apply for a lean transformation program across the company at a later stage. Notably, a number

of lean tools and practices observed in the company include KANBAN boards and Jira Software.

The same process previously discussed was adopted for the second case, therefore only results will be presented. Table (6-6) records the actual assessment figures provided by each expert and the relative importance weights for all enablers, criteria, and attributes. The index of each criterion is calculated; an example of this step is given by the calculation of the index for "Leadership Approach" criterion that is listed below:

Weights pertaining to the leadership approach criterion W_{11}= (0.13, 0.20, 0.35, 0.23)

Assessment scores pertaining to the leadership approach criterion is given by:

$$R_{11}=\begin{bmatrix}6 & 7 & 6 & 9 & 9 & 8\\ 8 & 7 & 4 & 7 & 7 & 6\\ 8 & 8 & 4 & 7 & 8 & 7\\ 4 & 8 & 3 & 6 & 9 & 7\end{bmatrix}$$

Index pertaining to the leadership approach criterion is given by

$$I_{11}= W_{11}\times R_{11}$$

$$I_{11}= (6.1, 6.9, 3.6, 6.3, 7.4, 6.2)$$

The indices relating to the other criteria have been computed using the same techniques, Table (5-7) present the calculated indices.

The third step is the calculation of the indices belonging to each enabler; an example for this is given by the calculation of the index for the "Leadership and Top Management" enabler, which is given by:

$$I_1=W_1\times R_1$$

Weight pertaining to the leadership & top management enabler is given by:

$$W_1= (0.40, 0.28, 0.28)$$

Assessment scores pertaining to the leadership & top management enabler is given by:

Table 5-6 Experts assessment scores and weights

E1	E2	E3	E4	E5	E6	W_{ij}	W_i	W		I_{ij}	I_i
6	7	6	9	9	8	0.13					
8	7	4	7	7	6	0.20	**0.40**				
8	8	4	7	8	7	0.35				I_{11}	
4	8	3	6	9	7	0.23					
6	6	5	5	8	6	0.30					
9	10	4	3	8	8	0.40	**0.28**	**0.25**		I_{12}	I_1
8	6	4	2	8	7	0.30					
9	6	4	9	7	6	0.28					
9	8	4	9	7	6	0.40	**0.28**				
6	9	4	6	7	8	0.28				I_{13}	
8	6	5	5	6	7	0.33					
6	6	5	8	6	6	0.33	**0.23**				
7	6	3	8	6	8	0.33				I_{21}	
6	8	8	10	5	8	0.35	**0.30**			I_{22}	
8	6	6	7	5	8	0.65					
7	4	9	8	6	6	0.35		**0.25**			I_2
6	7	7	5	6	7	0.28	**0.20**				
8	4	6	5	6	8	0.30				I_{23}	
7	6	9	7	8	6	0.28					
6	7	8	8	8	8	0.25	**0.28**				
7	8	6	6	8	7	0.45				I_{24}	
8	7	5	7	8	7	0.25					
9	5	4	8	7	8	0.28	**0.20**			I_{31}	
9	5	6	9	8	6	0.25					
8	6	3	6	6	6	0.20					
7	6	6	7	7	6	0.30					
8	6	4	7	7	6	0.38	**0.40**	**0.2**		I_{32}	I_3
7	4	6	7	6	7	0.28					
9	6	4	8	7	6	0.35					
8	6	6	8	7	6	0.33	**0.30**			I_{33}	
9	5	4	8	6	6	0.30					
9	9	6	9	7	8	0.25					
6	8	4	9	7	7	0.30	**0.50**			I_{41}	
8	8	5	7	8	8	0.25					
7	7	6	8	8	7	0.20					
8	5	7	5	7	8	0.23					
8	5	6	5	6	7	0.20	**0.28**	**0.1**		I_{42}	I_4
7	5	8	5	6	8	0.23					
7	7	8	5	8	9	0.33					
9	9	5	4	8	8	0.28					
8	8	7	6	8	7	0.35	**0.25**			I_{43}	
9	8	8	4	8	7	0.40					
9	7	7	6	6	8	0.20					
9	8	6	7	6	6	0.28	**0.18**			I_{51}	
7	5	7	7	6	7	0.30					
8	5	8	9	6	7	0.33					
7	5	6	9	6	7	0.33	**0.25**			I_{52}	
6	7	8	9	7	8	0.35					
7	7	7	6	7	6	0.25					
9	8	6	6	7	6	0.33	**0.15**	**0.15**		I_{53}	I_5
7	7	9	8	6	6	0.40					
8	8	7	7	8	5	0.25					
7	6	8	4	9	6	0.25	**0.25**			I_{54}	
8	6	6	3	8	7	0.28					
9	7	8	5	6	5	0.25					
7	8	7	7	8	6	0.40					
7	8	8	8	7	7	0.33	**0.15**			I_{55}	
8	6	6	9	9	5	0.28					

$$R1 = \begin{bmatrix} 6.1 & 6.9 & 3.6 & 6.3 & 7.4 & 6.2 \\ 7.8 & 7.6 & 4.3 & 3.3 & 8 & 7.1 \\ 7.7 & 7.3 & 3.8 & 7.7 & 6.7 & 6.3 \end{bmatrix}$$

Index pertaining to the supplier relationship enabler is given by:

$$I_1 = W_1 \times R_1$$

$$I_1 = (6.7, 6.9, 3.7, 5.6, 7.0, 6.2)$$

Table 5-7 Calculated indices for all criteria (per expert)

	E1	E2	E3	E4	E5	E6
I_{11}	6.1	6.9	3.6	6.3	7.4	6.2
I_{12}	7.8	7.6	4.3	3.3	8.0	7.1
I_{13}	7.7	7.3	3.8	7.7	6.7	6.3
I_{21}	6.8	5.9	4.2	6.8	5.9	6.8
I_{22}	7.3	6.7	6.7	8.1	5.0	8.0
I_{23}	6.5	4.5	6.9	5.7	5.6	6.4
I_{24}	6.6	7.0	7.2	6.6	7.8	6.8
I_{31}	8.3	5.6	4.5	7.4	7.1	6.7
I_{32}	7.0	5.2	5.0	6.7	6.4	6.0
I_{33}	8.5	5.6	4.6	7.8	6.5	5.9
I_{41}	7.5	8.1	5.2	8.3	7.5	7.5
I_{42}	7.3	5.5	7.2	4.9	6.7	7.9
I_{43}	8.9	8.5	7.0	4.8	8.2	7.5
I_{51}	6.4	5.1	5.2	5.2	4.7	5.4
I_{52}	7.0	5.7	7.4	9.0	6.4	7.4
I_{53}	7.5	7.2	7.3	6.7	6.4	5.9
I_{54}	8.2	6.9	7.4	4.8	8.0	5.9
I_{55}	7.3	7.5	7.1	7.9	8.0	6.1

Key: E= expert

The indices relating to the other lean enablers have been computed using the same techniques, Table (5-8) present the calculated indices.

Table 5-8 Calculated indices for all enablers (per expert)

	E1	E2	E3	E4	E5	E6
I_1	6.7	6.9	3.7	5.6	7.3	6.2
I_2	6.8	6.2	6.3	6.9	6.1	7.1
I_3	7.0	4.8	4.2	6.5	5.9	5.5
I_4	7.9	7.7	6.3	6.7	7.6	7.8
I_5	7.1	6.2	6.7	6.5	6.5	6.0

Key: E= expert

Fourth and final step is computing leanness index for ERP implementation process in the company, which id done as follow:

Overall weight: W= (0.25, 0.25, 0.20, 0.10, 0.15)

$$R=\begin{bmatrix} 6.7 & 6.9 & 3.7 & 5.6 & 7.0 & 6.2 \\ 6.8 & 5.2 & 6.3 & 6.9 & 6.1 & 7.1 \\ 7.0 & 4.8 & 4.2 & 6.5 & 5.9 & 5.5 \\ 7.9 & 7.7 & 6.3 & 6.7 & 7.6 & 7.8 \\ 7.1 & 6.2 & 6.7 & 6.5 & 6.5 & 6,0 \end{bmatrix}$$

Process leanness value: I= WxR

I= (6.6, 5.9, 5.0, 6.1, 6.2, 6.1)

I= 6.0

The leanness assessment tool has demonstrated that the leanness index for ERP implementation process in B company is 6.0, which is “Highly Lean”. This leanness level is acceptable considering the fact that the company has started using lean in its IT sector for the past two years only. This result indicates that

there is a room for improvement and enhancement in the company and its processes.

The index values and relative importance weight for the enablers are shown in Table (5-9); it revealed that the most important enabler is “Leadership and Top Management” based on the weight value. The remaining enablers are ranked in the order: Business Process, Employees, Vendor Relationship, and Consultant relationship. The table also shows that the “Employees” enabler has the least leanness index; which recommends starting the improvement process with.

Table 5-9 Calculated indices for all enablers (per expert)

Enabler	Index	Weight
Leadership & Top Management	6.0	0.30
Business Process	6.6	0.25
Employees	5.7	0.20
Consultant relationship	7.3	0.10
Vendor Relationship	6.5	0.15

◈ *Employee enabler*

Table 5-10 displays index values and relative importance weight for the criteria related to employees’ enabler. Employee Involvement criterion has been given high weight by the experts while its index turned out to be the lowest. Employees’ engagement is very important to the success of ERP implementation thus; B is recommended to enhance this area by involving employees at an early stage. In order to reduce uncertainty and reach good buy in from employees, it is critical to inform employees about upcoming changes early in the project. Some other improvement actions for employees’ enabler are:

-Communication of the company’s mission and values

-Recognising and encouraging innovation

-Building an effective feedback system

Table 5-10 Indices and weight for criteria related to “Employee” enablers

Criteria	Index	Weight
Employee Status	6.6	0.2
Employee Involvement	6.0	0.4
Employee Culture	6.5	0.3

◈ *Leadership and Top Management enabler*

Table 5-11 presents index values and relative importance weight for the criteria related to Leadership & top management. Leadership approach criterion has been given high weight by the experts while its index turned out to be lowest. This enabler could be enhanced by:

-Valuing people and nurture relationships

- Embracing an impeccable standard of excellence

- Putting the team/ employees first

Table 5-11 Indices & weight for criteria related to “Leadership” enablers

Criteria	Index	Weight
Leadership approach	6.1	0.4
Management Practice	6.4	0.3
Management Culture	6.6	0.3

◈ *Business Process enabler*

Table 5-12 presents index values and relative importance weight for the criteria related to Business Process enabler. Because of the low index values, it is recommended to start improving Process Streamlining criteria and then Process Optimisation. Applying a value stream mapping tool should be very effective in improving this area, some enhancement actions are as follow:

-Revisiting business processes and defining single work processes.

- Applying continuous improvement strategies

- Implementing workflow improvements

Table 5-12 Indices & weight for criteria related to “Process” enablers

Criteria	Index	Weight
Process Optimisation	6.1	0.2
Process Flexibility	7.0	0.3
Process Streamlining	5.9	0.2
Process Improvement	7.0	0.3

◈ *Vendor Relationship enabler*

Table 5-13 presents index values and relative importance weight for the criteria related to vendor relationship enabler. The vendor support criterion is the most critical one to start improving; it has high weight value and a relatively low index rate. This enabler could be enhanced by:

-Considering the availability of competent and responsive vendor support in the vendor evaluation process

- Making sure the cost of support is reasonable

- Checking the location of support office where time difference and language could be a barrier, and make sure it is within acceptable proximity.

Table 5-13 Indices & weight for criteria related to “Vendor” enablers

Criteria	Index	Weight
Vendor Leanness	5.3	0.2
Vendor Quality	7.1	0.3
Direct / partner	6.8	0.2
Vendor Support	6.9	0.3
Vendor Development	7.3	0.2

◈ *Consultant Relationship enabler*

Index values and relative importance weight for the criteria related to consultant relationship enabler are shown in Table 5-14. The criterion of “Consultant Experience” has the highest weight value among all 18 criteria. This enabler could be enhanced by:

- Making sure a consultant has thorough experience implementing ERP systems

- The consultant should have knowledge of company's business

- Good experience with ERP system to be implemented

Table 5-14 Indices & weight for criteria related to "Consultant" enablers

Criteria	Index	Weight
Consultant Experience	7.3	0.5
Consultant Leanness	6.6	0.3
Consultant Development	7.5	0.3

5.2.4.3 Case Study (C):

This case is a government department that provides services to the residence of Makkah region. Saudi government introduced an e-government strategic plan in 2010 and urged each government department to make available e-services to the public domain. Case (C) is in the process of implementing a number of solutions and upgrades to its legacy based systems, for such a complex organisation such an endeavour is a strenuous and require careful planning. Having provided an overview of the three organisations selected for the case studies, a section has been dedicated in the upcoming reading for each case. The details of each case with references to the results from the assessment are presented. Based on the aforementioned approaches in the previous two case studies, results from the third case study are presented here. Table 5-14 presents the actual assessment figures provided by each expert and the relative importance weights for all enablers, criteria, and attributes. The index of each criterion is calculated; an example for this step is given by the calculation of the index for "Leadership Approach" criterion that is shown as follows:

Weights pertaining to the leadership approach criterion W_{11}=(0.10, 0.20, 0.40, 0.30)

Assessment scores pertaining to the leadership approach criterion is given by:

$$R_{11}=\begin{bmatrix}6 & 7 & 6 & 9 & 7 & 2\\ 5 & 7 & 4 & 7 & 6 & 5\\ 3 & 5 & 4 & 7 & 9 & 7\\ 4 & 4 & 3 & 6 & 7 & 7\end{bmatrix}$$

Index pertaining to the leadership approach criterion is given by $I_{11}=W_{11}\times R_{11}$

$$I_{11} = (4.0, 5.3, 3.9, 6.9, 7.6, 6.1)$$

The indices relating to the other criteria were computed using the same techniques, Table 6-14 present the calculated indices. The third step is the calculation of the indices belonging to each enabler; an example for this is given by the calculation of the index for the "Leadership and Top Management" enabler, which is given by: $I_1 = W_1 \times R_1$

Weight pertaining to the leadership & top management enabler is given by:

$$W_1 = (0.40, 0.30, 0.\ 30)$$

Table 5-15 Experts assessment scores and weights

E1	E2	E3	E4	E5	E6	W_{ij}	W_i	W
6	7	6	9	7	2	0.1		
5	7	4	7	6	5	0.2		
3	5	4	7	9	7	0.4		
4	4	3	6	7	7	0.3	**0.4**	
2	6	5	5	8	5	0.3		
4	3	4	3	6	8	0.4		**0.2**
8	6	4	2	8	4	0.3	**0.3**	
6	6	4	9	5	2	0.3		
2	8	4	9	7	6	0.4		
3	4	4	6	5	5	0.3	**0.3**	
5	6	5	5	6	3	0.3		
5	6	5	8	6	5	0.3		
5	6	3	8	6	8	0.3	**0.3**	
2	3	4	7	5	4	0.4		
4	6	2	7	5	6	0.7	**0.3**	
3	4	2	3	6	5	0.4		**0.3**
4	7	2	5	6	5	0.3		
3	4	3	5	6	5	0.3	**0.2**	
5	3	4	7	3	6	0.3		
4	7	2	1	5	4	0.3		
3	2	4	1	8	7	0.5	**0.2**	
5	7	5	6	3	7	0.3		
2	5	4	5	7	5	0.3	**0.3**	
4	5	3	7	4	6	0.3		
6	6	3	8	6	6	0.2		
3	6	2	7	7	6	0.3		
3	6	4	5	5	6	0.4	**0.4**	**0.3**
4	4	2	7	7	4	0.3		
6	6	4	3	4	6	0.4		
5	6	4	4	7	6	0.3	**0.3**	
4	5	4	5	4	6	0.3		
5	4	6	4	7	5	0.3		
6	5	4	5	7	7	0.3	**0.5**	
4	2	5	7	8	5	0.3		
5	7	6	3	8	4	0.2		
6	5	4	5	7	3	0.2		
5	2	3	5	6	4	0.2	**0.2**	**0.1**
4	3	4	5	6	3	0.2		
4	7	2	5	3	6	0.3		
3	3	5	4	2	3	0.3		
5	4	4	6	8	7	0.4	**0.3**	
6	2	4	4	3	7	0.4		
3	4	2	6	6	4	0.2		
3	2	6	4	6	6	0.3	**0.2**	
4	5	4	4	6	7	0.3		
4	5	5	9	6	7	0.3		
4	5	6	5	6	7	0.3	**0.3**	
6	7	5	9	7	5	0.4		
7	7	5	4	7	6	0.3		
5	2	4	6	7	3	0.3	**0.2**	
5	5	3	8	6	6	0.4		**0.2**
7	4	3	4	5	5	0.3		
5	4	4	4	5	6	0.3	**0.2**	
3	6	4	3	5	7	0.3		
1	2	4	5	5	5	0.3		
3	8	5	4	5	6	0.4		
7	8	4	3	5	7	0.3	**0.2**	
4	6	3	6	5	5	0.3		

Table 5-16 Calculated indices for all criteria (per expert)

	E1	E2	E3	E4	E5	E6
I_{11}	4.0	5.3	3.9	6.9	7.6	6.1
I_{12}	4.6	4.8	4.3	3.3	7.2	5.9
I_{13}	3.5	6.2	4	8.1	5.8	4.5
I_{21}	4.9	5.9	4.2	6.8	5.9	5.2
I_{22}	3.3	5.0	2.7	7.0	5	5.3
I_{23}	3.1	4.5	2.15	3.9	5.6	4.6
I_{24}	3.7	3.5	3.4	2.6	5.7	5.8
I_{31}	4.0	5.6	3.7	6.2	4.9	5.8
I_{32}	3.1	5.2	2.7	5.9	5.9	5.2
I_{33}	4.9	5.6	3.9	3.9	4.9	5.9
I_{41}	5.1	4.4	5.2	4.9	7.5	5.4
I_{42}	4.6	4.5	3.1	4.9	5.1	4.1
I_{43}	5.0	3.0	4.4	4.8	4.6	6.1
I_{51}	2.6	2.9	3.3	3.5	4.7	4.6
I_{52}	4.7	5.7	5.3	7.7	6.4	6.3
I_{53}	5.4	4.4	3.8	6.2	6.4	4.9
I_{54}	4.1	4.2	3.9	4.1	5.1	5.9
I_{55}	4.6	7.5	4.1	4.2	5.0	6.1

Key: E= expert

Assessment scores pertaining to the leadership & top management enabler is given by:

$$R_1=\begin{bmatrix}4.0 & 5.3 & 3.9 & 6.9 & 7.6 & 6.1\\ 4.6 & 4.8 & 4.3 & 3.3 & 7.2 & 5.9\\ 3.5 & 6.2 & 4.0 & 8.1 & 5.8 & 4.5\end{bmatrix}$$

Index pertaining to the supplier relationship enabler is given by:

$$I_1=W_1\times R_1$$

$$I_1= (4.0, 5.4, 4.1, 6.2, 6.9, 5.6)$$

The indices relating to the other lean enablers was computed using the same techniques, Table 5-17 present the calculated indices.

Table 5-17 Calculated indices for all enablers (per expert)

	E1	E2	E3	E4	E5	E6
I_1	4.0	5.4	4.1	6.2	6.9	5.6
I_2	3.8	4.8	3.2	5.5	5.5	5.2
I_3	3.9	5.4	3.3	5.4	5.3	5.6
I_4	4.9	4.0	4.5	4.8	6.1	5.3
I_5	4.2	4.9	4.2	5.4	5.6	5.6

Key: E= expert

Fourth and final step is computing leanness index for ERP implementation process in this organisation, which id done as follow:

Overall weight: W= (0.20, 0.30, 0.30, 0.10, 0.20)

$$R=\begin{bmatrix} 4.0 & 5.4 & 4.1 & 6.2 & 6.9 & 5.6 \\ 3.8 & 4.8 & 3.2 & 5.5 & 5.5 & 5.2 \\ 3.9 & 5.4 & 3.3 & 5.4 & 5.3 & 5.6 \\ 4.9 & 4.0 & 4.5 & 4.8 & 6.1 & 5.3 \\ 4.2 & 4.9 & 4.2 & 5.4 & 5.6 & 5.6 \end{bmatrix}$$

Process leanness value: I= WxR

$$I= (4.1, 5.0, 3.7, 5.5, 5.8, 5.5)$$

$$I= 4.9$$

The results from the assessment have indicated that the leanness index for ERP implementation process in Makkah municipality is 4.9, which can be

considered “Normally Lean”. This leanness level is more than satisfactory for a public sector organisation with the limited resource; however, these results indicate that there is an open opportunity for improvement and enhancement in the organisation and its processes.

The index values and relative importance weight for the enablers are shown in Table 5-19; it revealed that the most important enabler is “Business Process” and “Employees” based on the weight value. The remaining enablers are ranked in the order: Business Process, Leadership and Top Management, Vendor Relationship, and Employees.

Table 5-18 Consolidated indices and weight for enablers

Enabler	Index	Weight
Leadership & Top Management	5.4	0.20
Business Process	4.7	0.30
Employees	4.8	0.30
Consultant relationship	5.0	0.10
Vendor Relationship	5.0	0.20

5.3 Change Management

Nowadays, organisational restructuring, processes reengineering and technological upgrades are inevitable, and for organisations to succeed they need to maintain high change momentum in order to sustain their competitive advantage. Chapter two discussed the importance of change management for organisations to thrive in the ever-changing business landscape.

The nature of ERP implementation projects entails a substantial amount of change on different aspects in the organisation such as the people, the processes and the IT systems. Finney and Corbett (2007) argue that change management is “one of the most critical of all ERP implementation success factors”. Managing cultural change has also been identified as one of the critical success factors for applying lean principles and tools, (Netland, Schloetzer and Ferdows, 2015) Netland (2015). The developed ERP implementation model in

this research included the use of lean principles and tools; thus, change management initiative is an essential element in the model.

5.3.1 Change in ERP implementation

Gilley et al., (2008) argue that a large amount of literature attests to the fact that successful implementation of organisational initiatives and projects are highly influenced by effective change management. In support of this argument, Kerzner (2013) assert that organisational change has a significant impact on the initiation and implementation of projects, change is an anticipated outcome of major project implementations, and excellent change management has a noticeable impact on projects success. The implementation of strategic changes is always a business difficulty that cannot be tackled by focusing only on project management approaches as explained by Leybourne (2007). One of the significant enablers for the successful acceptance and use of information systems is the good management of the associated socio-technical change (Bostrom and Heinen 1977).

The implementation of an ERP system always instigates major change to the organisation but many overlook this aspect, which leads to difficulties or failure to implementation (Kwahk and Lee, 2008). Usually, implementing an ERP system result in some sort of restructuring of the organisation. This change needs to be well thought off to avoid any possible miss alignment in functionalities and make sure that the streamline of work is flawless and efficient. Moreover, the introduction of ERP system to an organisation touches on, directly and indirectly, a large number of people and this create anxiety and fear within employees of all levels (Foster et al. 2007). A number of managers might look at the new system as a source of potential threat to their administrative power (Kemp and Low 2008). Those managers could form sort of allies and opposition groups to stop the alleged threats. Some users of the ERP system will perceive the change in the, used to, way of doing business as risk (Foster et al. 2007). The types of resistance form miss informed users vary between silent to intended low performance.

Business processes are one of the major critical success factors of ERP implementation and changes in these processes are inevitable (Foster et al. 2007). Change management help in addressing this issue and enable the organisation to mitigate all possible risks that might rise from the new methods of delivering businesses. In some cases of ERP implementation, organisations build an interface between their ERP system and the suppliers' systems (Mabert et al. 2003). This is a type of change that most of the time is overlooked and result in negative reactions from suppliers that might jeopardise the business.

Change management helps to propagate the voice of employees who are in favour of the change, which will have a positive effect on those who are against the change and resisting it (Stebel, 1992, Masa'deh et a., 2015, Obeidat et al., 2016). Change management has been a focus area of research in the ERP implementation landscape.

5.3.2 Applying Kotter's model

The literature revealed the existence of a number of models to manage change where each model has its feature and characteristics. Chapter (2) presented some of the most widely used change models in the industry. The initial analysis suggests that Kotter's change model is the best-suited and most efficient model for ERP implementation projects. The implementation of Kotter model is based on a staged approach and planned change, which goes well with the nature of ERP implementations.

There are variances between the way change management presented and the way it is practiced (Saka, 2003). This argument is supported by the conclusion of Appelbaum et al. (2012), which emphasise on the need for more practical researches that help practitioners in applying change management in real life. Studies by Cole et al. (2006) and Paper et al. (2001) assert on the importance of how the actual application of a change management is executed. This section is presenting some guidelines to apply Kotter's change model during ERP implementation project.

The first principle in Kotter's change model is to appoint "many change agents, not just the usual few appointees" (Kotter, 2012). This principle is reflected in the developed ERP implantation framework as one of the activities of the first stage. Organisations could create a pool of change agents by asking their employees, from all managerial levels, to volunteer for the post and apply for it. The benefits of this approach are that it will attract resources who are willing lead change and passionate about it. Moreover, the approach will cost much less than hiring outside resources and the quality would be better because internal employees are familiar with the culture and have a good understanding of the business.

One of the important principles of Kotter's accelerate model is 'two systems, one organization". This principle refers to two types of organisational structure; one is the classical management-driven hierarchy of the organisation structure and the second is a dynamic more agile network, where both are working in a conjoined and synchronized way. This setup works well in the context of ERP implementation project with the project teams resembling the network structure. The dual operating system is not introduced as two competing or contradicting departments; rather it should be two structures that complement each other.

The eight steps (named as Eight Accelerators) of Kotter's model could be applied in the ERP implementation context as follows:

i) Create a sense of urgency around a single big opportunity. The change team need to prepare strong effective massages that clearly demonstrate the benefits of the new ERP system and the potential threats if the system is not implemented. The massages should be developed in different forms to address the diverse mind-sets of employees. Kotter asserts that failing to create a sense of urgency is a major mistake and will lead to the failing of the change initiative. Top management needs to embrace the sense of urgency and keep it ongoing throughout the project duration, they need to make sure that all employees are on the same pace. When employees are encouraged to take daily actions that help them attain the final goals, the sense of urgency will act as a competitive advantage in the organisation.

ii) Build and maintain a guiding coalition. In ERP projects, this coalition is the change management team within the project team. It is essential to form the coalition as a flat structure where all members are equal; this will create a dynamic team that act swiftly with less bureaucracy. The change team should be fully authorised to take immediate decisions on which change activity to implement and when to do it. They need to interact with all involved parties; within the project team, in the departments, and the external suppliers. Organisations that are formed in silos and used to work with the strict hierarchical system will find some challenges in applying this approach at the beginning, but it will be smoother once the members absorb the concept.

iii) Formulate a strategic vision and develop change initiatives. Top management should inspire the change team to formulate a vision that guides the project team to fulfil the ultimate goal of delivering an efficient working system. The vision should emphasise the targeted big opportunity for the main organisation as well as the project team. Kotter (2012) define the right vision as being “feasible and easy to communicate. It is emotionally appealing as well as strategically smart”. The guiding coalition needs to set some change initiatives that are critical to attain the vision, communicating the change plan is one of the very important initiatives in change management.

iv) Communicate the vision and the strategy. No matter how good the change strategy and planning is, it will face the risk of failure if it is not communicated well. The guiding coalition needs to design a creative communication campaign that touches on the need of all stakeholders in order to acquire the buy in from them.

Following are some examples of what the communication massages could address. Reassuring employees that introducing a new ERP system will not lead to layoffs, and that transferring employees from one position to another is beneficial to all parties. Another massage could highlight how modifying some of the current business processes will reduce the time or effort required by staff. For the communication campaign to be successful massages should be memorable and authentic and top management should always emphasise on

this aspect. Use all possible communication channels such as (emails, posters, roll-ups, seminars special event, and all available social media). The massages need to be augmented in every event that takes place during the implantation period. The communication campaign should start well before the project kicks off.

V) Accelerate movement toward the vision and the opportunity. Obstacles and hurdles that arise during the project phase have to be treated and removed as fast as possible. Any delays in addressing problems could create more resistance and result in the loss of the gained enthusiasm. In a modular implementation of ERP system, high level of prompt support should be provided to keep the momentum level of the employees during the next phases. Furthermore, the impact of pulling employees from their daily job to work on the project should be assessed frequently and make sure not to affect the performance of the main organisation and the project team.

vi) Celebrate short-term wins. When implementing ERP systems, the project team need to plan for some quick wins such as noteworthy deliverables at the very early stage of the project. Acknowledging and celebrating such noticeable gains will raise the confidence in the change and reinforce the position of the guiding coalition. The first round of training and first successful test are some of the activities that could be celebrated.

vii) Keep learning from experience. It is important for the change team to notice and document the lesson learned during each phase of ERP implementation. These lessons should be utilised to build some preventive measures and avoid mistakes in the following phases. The team is required to stipulate great efforts in maintaining the cultural and political resistance level. This approach will reinforce the creditability of the change team because it shows that the team is practicing what they are breaching.

viii) Institutionalize strategic changes in the culture. The developed ERP implementation framework is built based on lean principles which mandate continuous improvement. The top management along with the change team are urged to plan to incorporate the change in the culture of the organisation as the

project progress. The aim should be to make change a habitual practice within employees, which will create a competitive advantage and empower the organisation to lead change rather than react to it.

Finally, the eight accelerators of Kotter's model could be used simultaneously unlike the older version of the model which required the sequential implementation of the steps (Kotter 2012). Considering this characteristic, the researcher developed a proposal to integrate the eight accelerators of Kotter into the eight stages of the developed ERP implementation process Figure (5-11) illustrates the final mapping outcome. At each implementation stage, the change accelerators could be applied to a certain extend; fully, partially, or not at all. The Harvey ball notion indicates the range of applying the accelerator across the organisation during the specific stage. Considering the fourth accelerator (Communication), it should be applied in all stages but with different intensities in each stage

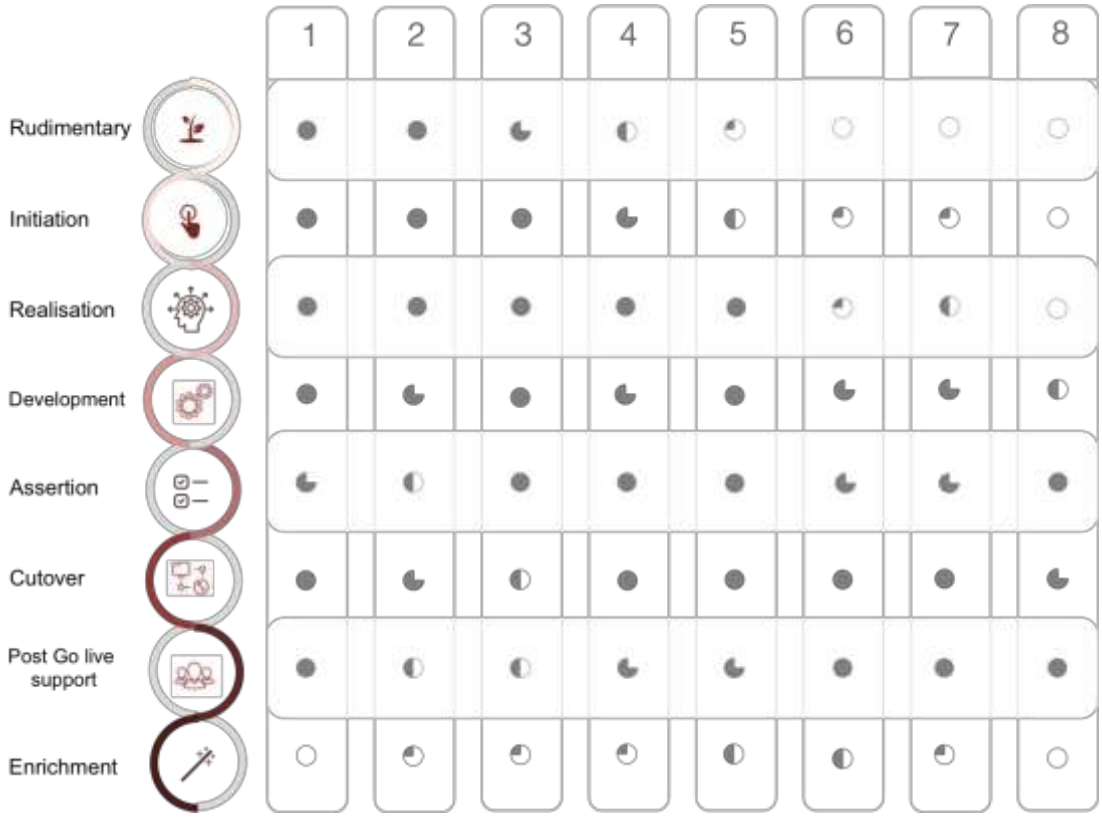


Figure 5-11: Mapping Kotter's Accelerators to ERP Implementation Stages

5.4 OBEYA Room

Visual management is presented in the literature review in Chapter 2, its benefits and importance are realised in providing practical support to project team. Obeya room is an effective and practical lean tool and it is a very good enabler for the visualization concept, it helps in monitoring the progress of individual projects or a portfolio of projects.

Obeya is added to the ERP implantation framework as a fundamental component because of its anticipated advantages and the constructive impact it will have on the project.

5.4.1 History of Obeya

The origin of the OBEYA concept started in a project by Toyota in the 1990s during the introduction of the first generation of Prius hybrid cars, its translation is “war room” or “performance room” (Morgan and Liker 2006). Toyota had an aggressive timeframe to introduce the Prius to market; which required excessive collaboration, transparency, and speed of decision making. The chief engineer of the Prius introduced the concept of the Obeya room to serve two goals; efficient management of information and prompt actions to raising issues. The use of Obeya room fulfilled all requirements and helped in introducing the new car within three years. As the Prius project advanced, it achieved very good outcomes that made Toyota Company incorporate the Obeya tool in its Toyota Production System (TPS) as a standard element (Osono et al 2008, Aasland and Blankenburg; 2012).

The use of Obeya started to spread across other industries as one of the practical lean tools. Jansson, et al. (2015) used the Obeya room within a method called Knowledge Innovation / Visual Planning (KI-VP) in a construction project that led to improving the production flow. The room was used for design process breakdown and validated through a case study at one of the leading industrialised house building companies in Sweden. Moreover, Mottonen et al (2009) concluded that the use of Obeya is one of the recommended solutions to the main challenges of managing requirements in the ICT sector. They analysed the case study and found that business needs are not addressed adequately in the process of requirement gathering. In the Obeya set up, a high level of cross-functional collaboration occurred as a result of the elevated involvement from the members of the project team. This is neutralised the old practice where the chief engineer is the one responsible for the ongoing communication (Morgan and Liker 2006).

More recently the virtual Obeya concept was introduced to serve the demand of international enterprises with dispersed sites across the globe (Tyagi et al.; 2015-iObeya). It uses digital boards as virtual walls where all project charts, schedules, and status reports are posted. Unlike the physical Obeya, the

employees' interaction level in virtual Obeya is not as efficient. However, it is very effective and economical solution for multisite corporations as it facilitates real time collaboration, practical knowledge sharing, and efforts coordination (Tyagi et al.; 2015).

5.4.2 Benefits of Obeya

One of the benefits of the Obeya room is the enhancement of the cross-functional collaboration within the project teams; this includes consultants and vendors (Hoppmann et al. 2011). In the Prius project, Obeya was the place for daily meetings with it walls mounted with charts, schedules, resources details, and status reports. The room was used for all components of the car to create excellent synchronisation between the different development team (Morgan and Liker 2006). Obeya room is an excellent enabler of visualization; its walls have updated information illustrating the status of the project. Accumulating and managing information is one of the main goals of Obeya, and presenting this information in simple color-coded format is a main task in the Obeya room. The mounted project charts on the walls with brief and concise information work as a dashboard for the project team providing them with quick insight on project status (Javadi et al.; 2012).

Obeya became one of the very effective tools for project management. Usually, project teams from multiple functional areas attend the Obeya room throughout the duration of a project; frequency and length of the meetings are among the responsibilities of the project's sponsor or the room facilitator. These meetings help to expedite the decision making process with the participation of all involved people. It enables the team to visualise the progress of the project, anticipates issues and challenges, and take the necessary proactive actions to avoid them.

In ERP implementation project, an Obeya set up will get employees from different functional areas to meet in a central location where they can, discuss project information and progress, and solve persisting challenges. With all ERP project information well presented on the walls and progress status clearly

identified, project teams could easily contemplate probable problems and take actions to prevent them.

Applying the concept of Obeya will add value to the communication process and leads to enhanced team collaboration, fewer hurdles between team members, and an information sharing environment (Javadi et al.; 2012). Obeya room is a tool that helps the project team visualise the full picture of the project status and take informed collaborative decisions.

5.4.3 The use of Obeya

The use of Obeya room and its functionalities are well defined in Toyota Production System (TPS). The adoption of Obeya concept by other industries is successful and it helped them achieve affirmative results by simplifying complexity and visualizing progress. This section will demonstrate the utilization of Obeya in ERP implementation projects.

Obeya is not just a Gantt chart on a wall, it is an ample concept based on collaborative work and visualisation. It is advised to allocate a space for the Obeya at the very first stage of the implementation process. It is essential to select a space with proximity to where most of the users are located, it is important to consider all stakeholders in the selection criteria. Ideally organisation needs to assign a large room for the Obeya, however, if the organisation is suffering from a shortage of spaces then a straight long wall could be used. The assigned room should have large areas of usable walls and equipped with all required materials. All materials on the walls should be arranged in a logical sequence, have very clear definitions, and above all use simple communication attributes. The room should be designed as a communication center with highly visual charts that deliver the important information at first glance. The use of colors in reflecting the status of activities is an essential requirement to have effective visual communication.

The materials on the walls must not be static; they should be updated as actions or incidents take place and should follow the stages of the ERP implementation process. Some of the basic materials expected to be seen on

the walls are:

- Project objectives and vision
- High-level project schedule with the baseline reflecting the progress
- Detailed chart for each task with daily plans
- Allocated resource to each task with the rate of involvement
- Issue status chart (Open, under process, and closed)
- Drawing or maps as required

Some of the lean tools that are useful in such projects are the A3 form and value stream mapping (VSM). The use of A3 forms in defining the tasks and activities will lead to standardised processes and improved performance. Obeya room is a perfect place to do VSM exercise for business processes improvement. Sharing the current and future state maps with all stakeholders will help them appreciate the importance of fulfilling business and technical requirements.

Every member of the project team, regardless of the position or level, should attend the Obeya room and actively involved with the rest of the team. Stand up meetings and discussion sessions to be scheduled base on topic and functionality, and concerned personal to be invited. Top management could attend to follow up and discuss strategic issues, they will be able to take instantaneous dissections and provide support. Teams members need to be encouraged to update the progress status as frequently as possible and not to wait until things get complicated. Transparency and taking the initiative to provide feedbacks and comments are two important criteria for the project team. The frequency of the meetings and attendees list should be planed and communicated, and everyone should observe it.

5.5 ERP Implementation Process Development

This section presents and discusses the fourth section of the framework, the implementation process. At this stage, the organisation should have assessed their readiness, triggered the change management initiative, and established the Obeya space. Building on the extensive literature review and industry collaboration, the author collectively combined the knowledge and

understanding of ERP Implementation and was able to generate a basic implementation process. The intention of the author was to start by generating a rudimentary base, which would then be developed progressively.

Table 5-19: First version of the developed implementation process

Phase	No	Activity Name
Needs Identification	1.1	Requirements Documents
	1.2	Replacement Driver
	1.3	Feasibility Study
	1.4	Request For Proposals (RFPs)
Package Evaluation & Selection	2.1	Proposals Analysis
	2.2	Evaluation Checklist
	2.3	Packages Benchmarking
	2.4	Selection of ERP Package
Implementation	3.1	Steering Committee & Project Manager
	3.2	Activity assignment
	3.3	Project Scope & Approach
	3.4	Allocate Resources
	3.5	Define Implementation Strategy
	3.6	As-Is Model
	3.7	Document Current Business Process
	3.8	Identify Gaps
	3.9	ERP Functionalities & Configuration
	3.10	Hardware Acquisition
	3.11	New Process Design
	3.12	System Prototype
	3.13	Design Forms & Reports
	3.14	System Customisation
	3.15	Data Cleansing
	3.16	Data Conversion program

	3.17	Application Interfaces
	3.18	Create Users Accounts
	3.19	Training Material
	3.20	Conduct Unit Testing
	3.21	Integration Testing
	3.22	Installation
	3.23	User Training
	3.24	User Acceptance Test
	3.25	Fine Tuning
	3.26	Data Migration
	3.27	Launch ERP
	3.28	Support Resources
	3.29	Parallel Testing
	3.30	Detect Anomalies
Post go live support	4.1	Resolve Issues
	4.2	Solve Business Process concerns
	4.3	Escalate Complex issues to second level
	4.4	Vendor Solve Complex issues
	4.5	Report System Performance
Maintenance	5.1	Release Upgrade
	5.2	Replacement Reasons
	5.3	Investigate Complex Error
	5.4	Support for New Release
	5.5	Investigate Potential Improvement

The first version of the developed implementation process with phases and activities is depicted in Table (5-19). The review reveals the scarcity in research addressing the full ERP implementation process as opposed to studies covering critical success factors. Most of the existing frameworks/models are not

comprehensive and do not cover the early stages of the process in details. Finally, none of the existing frameworks/models used lean principles and methodology to manage the implementation process.

5.5.1 Comparative Analysis

After searching and analysing the academic literature of ERP implementation process, this section presents a comparative analysis of some ERP Implementation approaches developed by academia, consultancy firms, and ERP vendors. This comparison is ought to expound on how each party perceive the implementation process and to explore the differences and similarities in the phases and activities. Usually, ERP vendors develop their own generic implementation methodology to help their customers in realising the phases and activities of the process

The analysis process started by identifying and selecting the sample processes to compare between them and to rigorously challenge the previously developed ERP implementation process. Initially, a sample of ten prevalent ERP implementation processes was identified, where a study of each process, including its associative technical material allowed the author to gain a deeper understanding of each process. The quality and contents of each process were examined, of which six were selected further for deeper study. The results from the comparative analysis are represented in a matrix, as shown in Table (5-20). The selected vendors are Oracle and Microsoft Dynamics because they are among the top five systems from a market share perspective. Although SAP is one of the most popular systems, it is not selected because most of the academic literature analysed their methodology in detail and built their proposed models and frameworks on it.

The two consultancy firms selected for this exercise are Panorama Consulting Group and Datix Inc. Both provide consulting services in ERP implementation and digital transformation and the have around 20 years of experience in the field. Panorama has an international presence while Datix works in the US and Europe.

Table 5-20: Comparative analysis of ERP Implementation processes

Samples representing ERP processes & assessment criteria / Process activities	Chang et al 2015 (Academic)	Ehie& Madsen 2005 (Academic)	Microsoft (*Vendor*)	Oracle (*Vendor*)	Datix (*Consultancy*)	Panorama (*Consultancy*)
Number of phases	5	6	8	5	3	5
Number of sub phases	0	0	0	0	6	0
Existence of Pre implementation phases	✓	✓	×	×	×	×
Readiness assessment phase	×	✓	×	×	×	×
Post Implementation Phases	×	✓	✓	✓	×	×
Cross-phases Activities	×	✓	✓	×	✓	×
Define implementation motive	×	✓	×	✓	×	×
Form steering committee	×	✓	×	×	×	×
Form project team	✓	✓	✓	×	✓	✓
Budget allocation	×	×	×	×	×	✓
Assess technology resources	✓	✓	×	×	×	×
Change management	×	✓	✓	✓	✓	×
Infrastructure evaluation	×	×	✓	×	×	×
Define scope and vision	✓	✓	×	×	×	✓
Start project communication	×	×	✓	×	×	✓
Create project plan	×	✓	×	✓	✓	✓

Identify roles & responsibilities	×	✓	×	×	✓	✓
Analyse current business processes	×	✓	✓	✓	✓	×
ERP system selection	×	✓	×	×	×	×
System configuration	✓	✓	✓	✓	✓	✓
Functionality design	×	✓	✓	✓	✓	×
Data migration design	×	×	✓	×	✓	×
Install production environment	×	×	✓	×	×	✓
Hardware installation	×	×	×	×	×	✓
Business processes customisation	✓	✓	×	✓	✓	✓
Develop user documentation	×	×	✓	✓	×	✓
Develop test scenarios	×	✓	✓	✓	✓	×
System modification	×	✓	✓	✓	✓	✓
System interface & Integration	×	✓	×	✓	✓	✓
Data conversion	×	✓	✓	✓	✓	✓
Conference room pilot	×	✓	×	×	✓	×
Cutover planning	×	×	×	×	✓	×
Develop transition process	×	×	×	✓	×	×
Conduct mass training	×	✓	×	✓	✓	✓
Final Testing	✓	✓	✓	✓	×	✓
Fine tuning	✓	✓	✓	✓	×	×
Go live	×	✓	✓	✓	✓	×
Resolve business process issues	×	✓	✓	×	✓	×
Continuous improvement / optimization	×	✓	✓	✓	✓	✓
Upgrade & expansion consideration	×	✓	✓	×	✓	×

The selected sample implementation models from the academic field are from the journal papers discussed in the previous section and are: Chang et al. (2015) and Ehie & Madsen (2005). These two papers are selected because they presented the most comprehensive processes among the others.

5.5.2 Key findings from the comparative study:

- Typically, ERP implementation processes are organised into phases or stages ranging from 5-8, with very few having number of main phases and sub phases.
- A considerable disparity is noticed in the activities during the pre-implementation phase, the reason is that the process of the vendors and consultants start after they are awarded a contract. From this point onward, the pre-implementation phase will refer to the activities that take place at the at the customer organisation in the very early stages before hiring a consultancy firm or a vendor.
- Pre-implementation activities are not formally considered by vendors and consultants; however, academics include this as an essential element of the complete process
- A number of activities prelisted in the processes such as: (1) Initiate change management, (2) proposal analysis and (3) evaluation checklists are not formally considered, however, some processes have made some indications to them. For example, Consultant D have raised the topic of initiating change management, highlighting its importance – however, no formal method is proposed
- The Implementation is usually a lengthy and time-consuming process, establishing a centralised operational hub ensures the flow of command and information is achieved from a pre-designated area. The benefits of this are numerous and contribute greatly to the success of the project. However, the existing processes do not mention this within their processes.

- ERP implementation is a highly costly project, careless decisions made by overlooking the associated risks can have detrimental effects on the system, and existing processes overlook this point.
- The study sample process has introduced some important activities during implementation: roll out planning, problem identification and resolution, business continuity assurance, optimal resource allocation, enforce mistake proofing for software developers, the synergy between multiple interfaces to ensure a smooth transition.
- Once the system goes online, it is essential to conduct fine-tuning, comprehensive testing as well as develop detailed reports on the system performance.

The author was able to further enhance the progress of the primitive process from the results obtained from the comparative analysis and used this as an opportunity to conduct additional complementary technical workshops to disseminate the findings as well as enhance the primitive process.

5.5.3 A Lean based workshop

The preceding increment of the process development sought to refine, enhance and complete the process. However, the need for a leaner approach (to ERP implementation) was justificatory evident from literature. In essence, the concept would propose a leaner approach to ERP implementation seeking to minimise time, cost and waste – whilst ensuring value was realised in an optimal manner. Furthermore, industrial practitioners were also seeking advancements in their current methods and endorsed the approach when proposed by the author.

Using lean in the enhancement of a process start by identifying the bottlenecks that make the flow of the process stumble or break. Kobus et al. (2017) assert that lean management (LM) philosophy used in production organizations can be easily transferred to the context of information technology (IT) industry with modifies definition for value and waste. They argue that many of the lean tools used in the manufacturing sector could easily be utilised for IT projects.

Johansson and Ryen (2017) conducted a research to identify waste and suggest approaches to reduce it in the software development department within ERP system provider (Infor M3). They argue that the area of lean software development and handling of waste is embraced by practitioners more than it is addressed in the academic field. Moreover, Lino and da Silva (2008) developed a framework to improve Information Technology Infrastructure Library (ITIL) processes using some of the lean tools and empirically applied it to a case study. Bradley (2007) presented the application of some of the lean principles to improve a data migration activity in a large system implementation.

5.5.4 Value Stream Mapping in IT / ERP

The Value stream mapping (VSM) method, Learn-To-See, of Rother and Shook's (1999) is well established, largely used, and accepted within the manufacturing industry. However, it is presence is much less and not frequently used in non- manufacturing industry Oppenheim, (2004). Furthermore, its applications in the IT / ERP industry is relatively unknown. Nash and Poling, (2008) argue that transactional process mapping started to overlap with the conventional production process mapping as a result of VSM advancement. Stadnicka and Ratnayake (2015) state that it is possible to apply VSM to analyse and improve the business process, and it will be as effective as in large manufacturing processes. Shou et al. (2017) conducted cross-sector comparisons for VSM implementations in five sectors: Manufacturing, Health care, Construction, Product development, and Service. Many researchers have discussed the successful application of VSM in the area of software development, and different methods and visualisations elements have been proposed Bin Ali et al. (2016), Khurum et al., (2014), Petersen et al. (2014), Staron and Meding (2011), Mujtaba et al (2010), and Poppendieck and Poppendieck (2003).

VSM is a Lean tool that reports the current state, classify activities and steps as value-adding or non-value adding, and lead the process to the improved future state Khurum et al., (2014); McManus, (2005). It is a prevailing tool to use for identifying opportunities for substantial improvement of processes.

The main purpose of using VSM in organisations is to identify and eliminate wasteful activities. Scrutinising ERP implementation process, many wasteful activities could be identified such as long and repeated test cycles, too many approvals, lots of consultants' conflicts, and long less productive meetings. Some of the main goals for VSM are objectivity, clarity, and persuasion. VSM helps optimizing processes by pinpointing bottlenecks that avert process flow jeopardise its capability.

Software development is one of the leading areas within the IT sector to apply VSM. Unlike software development, the transactional processes of ERP implementation contain many complex activities, and no standard VSM method has tackled all the issues involved in the ERP implementation process.

The basic symbol used for drawing the VSM was first presented in a software development context by Poppendieck and Poppendieck (2003).

It is important to measure different times of the activity in the process to attain an efficient VSM. Some of the commonly measured times in a VSM exercise are Processing Time, which is the net actual time spent on executing the activity/task excluding waiting, setup, and information gathering time. The Cycle Time is the actual processing time with the time required to finish that activity like setups and preparations. Finally, Elapse Time is the total time needed from the beginning of the activity until the output delivery, and including all waiting and transportation times.

Some of the basic steps in applying VSM are:

- Brake down the process or activity into its constituent tasks as much as possible
- Identify the relationships between the tasks
- Estimate the average working time required to complete each task
- Identify the average wait time between tasks in the process
- Calculate wasted time, and efficiency
- Define a real customer at the start and end of VSM

All VSM exercises start by mapping the current state of the value stream and breaking down the process to its least possible activities. All measured time should be reflected into the map, which indicates different processing and waiting times. The Current State Map is used as a baseline for assessment and enhancement of the process. Then, a Future State Map is to be developed and implemented by minimizing or eliminating all possible wastes.

5.5.5 VSM Workshop Methodology

In order to achieve a leaner ERP implementation process, consultation with highly technical and experienced personnel would be required, and the author was able to conduct two successful technical workshops. The overall objective of the workshop is to farther enhance the mature process, developed through the previous two steps, using value stream mapping technique. An equally important objective is to develop a detailed process that covers the very early phases of the implementation and to make sure that all stakeholders are involved and have integrated roles. The workshops helped to identify suitable lean tools and techniques for each activity of the process that could be employed for waste elimination. As a result of the workshops, a final ERP implementation process was achieved, this process was technically more advanced, organised and logical and its contents would ensure to materialise the concept of lean ERP implementation process.

The structure of the workshop was designed to accomplish three goals as follow:

The first goal is to identify the most critical wastes in each step and activity of the ERP implementation process.

The second goal is to evaluate the likelihood of the waste occurrence by considering the typical causes of these wastes.

The third goal is to extract some proactive considerations with a list of lean tools and technics that could help prevent or eliminate possible waste.

Participated experts are members of “Digital Project Managers London” group, which is part of the social network meetup.com, and the researcher is a member and a speaker in the group. The group focus on the topic of project and programme management from a digital perspective, and it discusses different delivery frameworks, methodologies and their associated challenges. The group has more than 3800 professionals with a mixed level of experience from different industry. All experts have a significant understanding and a good background in ERP implementation, and the range of years of experience for the experts is 7 – 15 years. Two of the experts have the tangible lean knowledge and the others have used some of the lean tools even though they do not have the full concept of lean.

Each workshop was two and a half hours long, were the first one had three industry experts and the second one with four. The workshop started with a presentation that had three main topics: scope of the workshop, the ERP process, and an introduction to lean principles and VSM applications. Then, the researcher presented to the panel of experts the developed ERP implementation process in the format of VSM. (Presented in Appendix I)

To create the current state VSM in manufacturing set up, time is measured with a stopwatch on the shop floor following the process from start to end. For the ERP implementation context, the workshop approach is followed to simulate the assembly line, and the precepts and concept of VSM are applied. Figure (7-4) illustrate the high-level approach of the workshop

To share a common ground, the group of experts agreed to consider all activities that consume time and resources but does not add any value to the process as waste. Poppendieck (2003) proposed a modified list of the lean wastes to be used in software development context, these seven different types of wastes are assumed in this research and they are depicted in Table (5-22).

Table 5-21: Waste in Manufacturing and Software development

	Lean Manufacturing Waste	Software development Waste
1	**Inventory:** intermediate work products and work in progress	**Partially performed work:** Any uncompleted work that does not have a value yet.
2	**Overproduction:** the number of items produced is higher than the number of items demanded	**Extra features:** Functionality that has been developed, but does not provide any value to customers
3	**Extra processing:** extra work is produced due to, for example, poor setup of machines	**Extra processes:** process steps that are not really needed
4	**Transportation:** transport of intermediate work /products	**Task switching:** Many handovers create an overload
5	**Excessive Motion:** machines and people being moved around rather than being used to create value	**Motion:** People may have to move to acquire knowledge
6	**Waiting:** an idle machine is waiting for input	**Delays:** Waiting times, like within a development team
7	**Defects:** fixing problems in the products	**Defects:** Technical problems or bugs

The experts were asked a number of questions:

1) Are the phases and activities complete and in a logical sequence? If not, what is your recommendation for the change?
2) Is the information in the map accurate and complete? If not what is

missing or should be changed?

3) Form your experience, what are the possible wastes that could occur within each activity of the process?
4) On a scale from 1-7 please indicate how likely for each identified waste to occur with 7 being “Most Likely”?
5) On a scale from 1-7 please indicate how critical is each waste, with 7 being “Highly critical”?
6) Considering the causes of occurrence of each waste, what lean tools and technics are recommended to help prevent or eliminate possible waste?
7) What is your overall evaluation of VSM as a method to assess the ERP implementation process?

The formatting of the questions was designed in a user-friendly structure to help in speeding the process of collecting feedbacks and maintain the quality at the same time, the details of which are recorded in Appendix B.

5.5.6 Results of VSM Workshop

The workshops were productive with very helpful outcomes; the presence of highly engaged professionals with enriched experience could be the reason behind this. However, it was not a simple task because of the complexity of the ERP implementation process where each activity could be analysed as a process by itself.

The group of experts indicated many areas of possible waste in the ERP implementation process. Presenting the activities of the original process in the form of current state VSM, the experts provided some comments on the sequence of some of the activities and suggested to add some and remove some other activities.

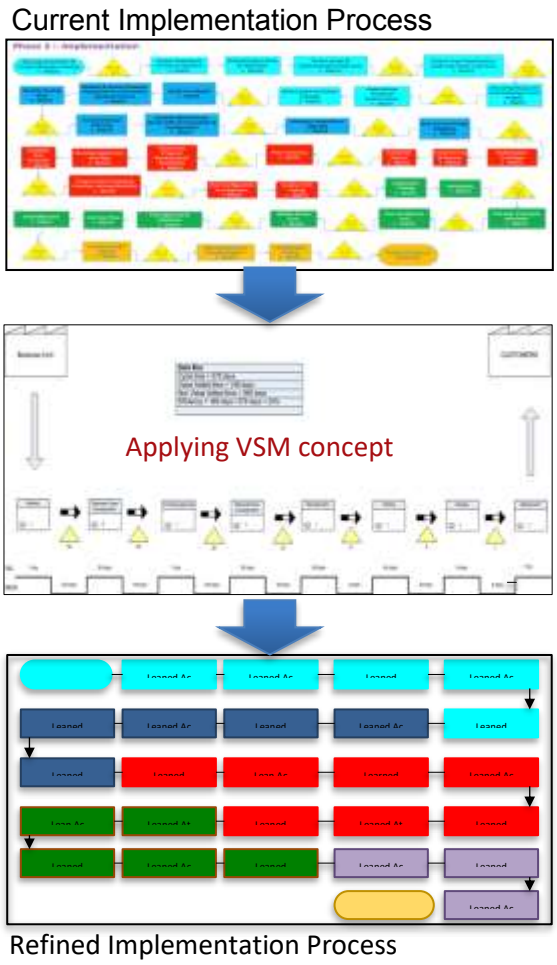


Figure 5-12: Illustration of the high level approach of the workshop

Figure (5-12) demonstrates the final phases and activities for the developed process. All the experts agreed on the importance to assess the readiness of the organisation for ERP implementation before they start any other activity. This early assessment will help organisations identify their capabilities and take the required countermeasures to improve and adjust.

The group of experts scrutinised each and every activity in order to identify all possible wastes that might occur throughout the process. The list of wastes developed by Poppendieck and Poppendieck (2003), as presented in Table (5-22), is used as a reference for this exercise. Table (5-23) depicts the possible wastes for each activity.

By analysing the results of waste identification, it is concluded that the most three common wastes are Delays, Extra processes, and Handover. Experts believe that delays are expected to occur in all of the 60 activities of the process. Waiting for things to happen is a common practice in ERP projects, and it leads to time wasting and frustrations within the project team. When the development team are waiting for specifications document to be signed and approved is a form of waste. Delays in issuing user IDs, delays in preparing the testing environment, and long unproductive meetings are sources of wastes. The waste is very critical because most practitioners take it as granted and think that it is the norm.

The second most common waste identified by the experts is “Extra processes”, which is appeared in 47 of the 60 activities (78.3%). ERP projects involve too many approvals and demand numerous unnecessary paperwork. The number of approvals required throughout the ERP lifecycle is very high in many cases, which lead to wasting long times in waiting. To minimize waste, every approval process has to be revised and keep only those required to maintain proper checks and balances. One effective way of reducing the cumbersome of approvals is by empowering the project team and streamline the decision making process.

Many lengthy reports are produced, weekly and monthly, during the project phases and disrupted to many people who do not read it. Some of the approvals and sign-offs are not necessary or take long times which result in non-value adding steps. Kanban boards and Obeya room concept are very effective means of communication and using them efficiently will lead to minimise the waste of paperwork.

The “Task Switching” waste is expected in more than 50% of the activities (31 activities), which makes it the third most common waste. Task switching with too many handovers create overload and lead to disruptions in the workflow. Some of the tasks of ERP implementation, like programing or coding, necessitate that the same person works without interruptions on the same task to keep focus. When a programmer stops working on a code to do another task,

then he or she will need more time to resume working on the first task. Assigning multiple resources to one activity could be a source of waste in certain cases. When the same resources do a repeated task every time, they will do it faster and with minimal defects.

The least possible waste to occur in the process is found to be “Extra features”, which is appeared in seven activities only. Application developers usually tend to provide extra features that are not required by the business or the customers, and thus they are considered non-value adding. Any feature, service, or product that is not required by the customer and require time or money to do it is considered a source of waste.

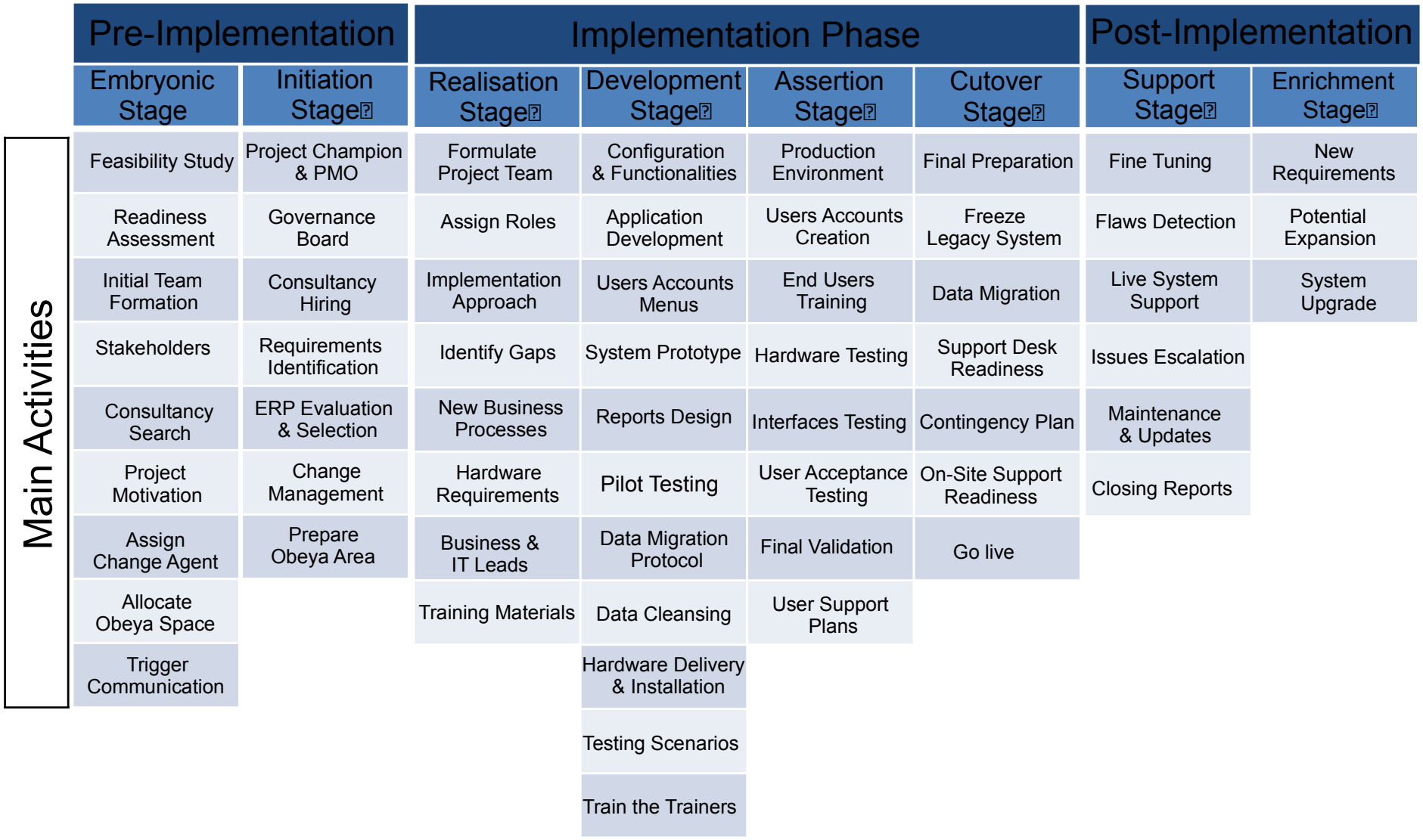


Figure 5-13: Final developed process with phases and activities

Table 5-22: List of activates with identified possible waste

Phase	Stage	No	Activity Name	Possible
Pre-Implementation	Embryonic	1.1	Feasibility Study	3 & 6
		1.2	Readiness Assessment	1,4,5, & 6
		1.3	Initial Team Formation	3 & 6
		1.4	Stakeholders	3 & 6
		1.5	Consultancy Search	3, 4, & 6
		1.6	Project Motivation	3 & 6
		1.7	Change Agent Assignment	3 & 6
		1.8	Obeya Space Allocation	2,3, & 6
		1.9	Trigger Communication	3,5, &6
	Initiation	2.1	Project Champion & PMO	1,3,4, &6
		2.2	Governance Board	3 & 6
		2.3	Consultancy Hiring	3, 4,5, & 6
		2.4	Requirements Identification	3, 4,5,6 & 7
		2.5	ERP Evaluation & Selection	1,3, 4,5,6 & 7
		2.6	Change Management	3,5, &6
		2.7	Building Obeya Area	1,3,5, &6
Implementation	Realisation	3.1	Formulate Project Team	3 & 6
		3.2	Roles Assignment	1,3, &6
		3.3	Implementation Approach	3 & 6
		3.4	Identify Gaps	3 & 6
		3.5	New Business Processes	2,3 & 6
		3.6	Hardware Requirements	2,3,5 & 6
		3.7	Business & IT Leads	3 & 6
		3.8	Training Material	1,3,5, & 6
	Development	4.1	Configuration & Functionalities	1,2,3, 4,5,6, & 7
		4.2	Application Development	1,2,3, 4,5,6, & 7
		4.3	Users Accounts Menus	2,3, 4,5,6, & 7
		4.4	System Prototype	3, 4,5,6, & 7

		4.5	Reports Design	3,4,5, &6
		4.6	Pilot Testing	4,5, & 6
		4.7	Data Migration Protocols	1,3,4,5, &6
		4.8	Data Cleansing	1,3,4,5,6, & 7
		4.9	Hardware Delivery & Installation	3, 4,5,6 & 7
		4.10	Testing Scenarios	1,3,4,5, &6
		4.11	Train The Trainers	3,5, &6
	Assertion	5.1	Production Environment	3, 4,5,6 & 7
		5.2	Users Accounts Creation	1,4,6 & 7
		5.3	End User Training	1,3, &6
		5.4	Hardware Testing	3, 4,5,6 & 7
		5.5	Interfaces Testing	3, 4,5,6 & 7
		5.6	User Acceptance Test	4,5, & 6
		5.7	Final Validation	3, 4,5,6 & 7
		5.8	Users Support Plans	3,4 &6
	Cutover	6.1	Final Preparations	3 &6
		6.2	Legacy System Freezing	6
		6.3	Data Migration	2,3,4,5,6, &7
		6.4	Support Desk Readiness	1,3, &6
		6.5	Contingency Plan	3& 6
		6.6	Data Migration	1,4,6, & 7
		6.7	On Site Support Readiness	1,3, &6
		6.8	Go Live	4 & 6
Post-Implementation	**Support**	7.1	Fine Tuning	1,4,6, & 7
		7.2	Flaws Detection	4 & 6
		7.3	Live System Support	1,3,4,5, &6
		7.4	Issues Escalation	3 & 6
		7.5	Maintenance & Updates	3,6, &7
		7.6	Closing Reports	4 & 6
	Enrichment	8.2	New Requirements	4 & 6
		8.2	Potential Expansion	6
		8.3	System Upgrade	6

Testing is one important and critical activity in ERP implementation process and if not managed well could entail lots of waste. It is recommended to make testing in short cycles and not to defer it until the last phase of the project. Testing involves different parties from different backgrounds and it is important to set well defined test seniors and clear differentiations between testing and on spot fixing of codes.

Hardware delivery and installation are one of the areas which is missed in most of previous the literature. The application of lean principles and VSM is very effective in managing the supply and connection of all equipment such as platforms, servers, and network elements. A large percentage of the hardware waste is tangible and could avoid if considered in the early stages of the project. The execution of data migration is a very labour intensive task that requires high synchronisation levels and accuracy. If not done with care, it could have a severe impact on the business and cost the organisation lots of money. Performing the migration in small batches and avoiding manual handoffs could increase the success rate of this activity.

The illustrative feature of value stream mapping help in addressing the root causes of problems and in identifying the possible wastes. During the workshop, it is noticed that as the group of experts started using value stream mapping they started reaching consensus in describing the issues of waste. The value stream map allowed them to see the whole and analyse the activities with an overall process perspective and highlight all possible non-value-added steps.

A guideline document that explains how to utilise the developed ERP implementation method and how to apply the recommended lean principles and tools, would be a helpful resource for implementers. Figure (5-14) depicts a sample page of the recommended guideline. The first section presents the name of the activity and a short description of what the source of failure and waste could take place during implementations. The second section is called lean proactive considerations and it contains three sub sections. It has a list of good practices, based on lean principles, that could be followed and assumed

by the project manager. The second sub section is the recommended lean tools that, which are expected to help to prevent the occurrence of wastes. Finally, a list of possible wastes is presented for the implementers to be ready and to take proactive measures.

Activity: Requirements Identification

Poor judgement in analysing and assessing the customer requirements leads to multiple predicaments, which will cascade and affect the proceeding activities (because this activity dictates the upcoming decisions).
Failure to fully comprehend the current business processes will lead to unclear requirements document, which will entail delays and work repetition.

Proactive lean considerations:

1. Good practise (based on lean principles):

a) Make sure business processes covers all possible scenarios
b) Ensure the business processes are clear and they are all documented that is accessible to employs
c) Engage employees throughout the process in defining system requirements

2. Recommended Lean tools and technique:

a) Use the aid of A3 to visualise all possible scenarios using root cause analysis
b) Use of Standardised and simplified forms
c) Use Obeya room fro meetings and post daily findings

3. Possible Wastes: 3, 4,5,6 & 7

Figure 5-14 Sample of a guideline page

5.6 Chapter Summary

This chapter presents the discussion on the four sections of the framework. The accomplished work can be summaries in the following points:

- Assessing the organisation readiness for ERP implementation is discussed and its significance to the success of the implementation project has been highlighted. Additionally, the chapter conversed the leanness assessment concepts and explored some of the previously developed models.
- The methodology of developing the assessment model is explained and a brief description of the steps is presented along with an illustration for the process.
- An overview of the leanness assessment model is depicted, with detailed explanations on the three levels of the model. A description for the enablers is provided highlighting their relevance to the readiness and leanness assessment.
- Furthermore, the chapter discussed the tool that is used to collect the evaluation input and calculate the leanness / readiness level at the organisation. A detailed explanation for the design of the tool and it features is provided accompanied with some illustrative figures.
- The section before last depicts the testing and validation of the model and its tool at three case studies. The results were highly indicative and the management of the three case studies were in agreement with assessment levels their organisations scored.
- Lean principles and tools are applicable in assessing readiness, and if adopted by the organisation would result in a more proactive culture that help in the success of ERP implementations.
- There is a common agreement form academics and practitioners on the importance and necessity for change management in ERP projects. Change in business processes and authority is inevitable in any ERP implementation, which always entails some forms of employees' resistance.

- The literature review findings and experts' opinions provided supportive justifications to employ Kotter's change model with ERP implementation projects. The latest update of Kotter's model (Accelerate) features the adoption of a more agile approach and the possibility of applying concurrent steps. These features make it more fulfilling to the complex nature of ERP implementation and beneficial in managing associated change.
- The Obeya room concept is relatively new to the other lean tools; however, its application in manufacturing and non-manufacturing sectors proves substantial benefits in keeping projects on track. The proper application and use of Obeya are expected to result in keeping projects on time and on budget. The visualization aspect that Obeya mandate makes the project more transparent and encourages team members to cooperate.
- The proposed ERP process has been developed using the extensive review to processes from academia, vendors, and consultants, followed by a detailed comparative analysis. The first model was then presented to industry experts for their feedback and validation. Industry experts participated in a value stream mapping workshop where the process is presented and possible area of waste identified. The final ERP process is developed based on outcome results of the workshop and incorporated into the framework.

Chapter 6

VALIDATION OF LEAN ERP IMPLEMENTATION FRAMEWORK

6.1 Introduction

The findings reported herewith denote the sequence of activities conducted as part of the validation of the lean ERP implementation framework. The framework validation is completed through real life case studies and experts' opinion. Having introduced the chapter in Section 6.1, the successiveness of the validation is attributed to constructiveness of the case study plan, which is described in Section 6.2. Given the nature of the research topic and the diverse capabilities of the framework two case studies that suffice the required criteria for a successful validation were selected and have been recorded respectively in Section 6.3 and Section 6.4. In continuation from the aforementioned case studies, an additional section has been allocated for validation through expert judgement; of which the results have been recorded in section 6.5. The key findings from the chapter are summarised in the final section.

6.2 Validation case studies introduction and plan

Authentication through validation of the research recorded by the author in this thesis can be considered as a critical element of this research project. This entails challenging the framework rigorously as a whole, with direct emphasis on the inner contents developed as well as its underlining 'lean' philosophy. The most applicable means of achieving this would be through live industrial case studies (Yin, 2013). Through engagement with industrial practitioners, the author was able to locate and secure two industrial case studies; one with the National Health Service (NHS) and the second within a Government sector – details of which will be presented in the forthcoming sections. In order to successfully complete the case studies in a professional and scientific manner,

the author was able to adopt a case study plan based on the works of Neale et al (2006) which served as a basic navigator. As shown in Table (6-1), the case study plan consisted of five stages. The scope and nature of both case studies required careful planning, the activities in this section ensured a suitable strategy was employed. Data collection and data analysis (covered in stage two and three respectively) were strenuous and required direct engagement, during these stages substantial data was generated and multiple opportunities for validation were identified. The fourth stage of the plan was concerned with the direct implementation of the developed framework. The final section sought to disseminate the findings of the case study in a professional document which would be shared amongst the participants.

Table 6-1: Case study plan (adopted from Neale, et al. 2006)

1. PLANNING
Identification, selection and securing the case studies
Conducting a thorough examination of the current state (AS-IS)
Identification of what material is required (and from whom)
Engage with stakeholders and conduct necessary interviews/surveys to capture knowledge
Ensure research follows international and national ethical research standards whilst taking in to consideration the companies policies
2. COLLECT DATA
Knowledge acquisition through collation and amalgamation of relevant documentation (including direct observations)
Conducting multiple interviews/survey/workshops with stakeholders
3. ANALYSE DATA
Conduct a thorough review and examination of raw material and identify key areas of improvement
Review all the data obtained through practical engagement i.e. multiple interviews/survey/workshops to provide practical lean solutions
4. VALIDATE LEAN ERP IMPLEMNTATIONFRAMEWORK
Treat each predicament as a single case and provide a detailed lean solution that is documented
Present the lean alternative solutions and implement wherever possible and monitor the effects for further improvements
5. DISSEMINATE FINDINGS
Solicit the feedback from respondents and compile the findings from the validation as a white paper
Revise the final document and disseminate amongst the team

Identifying suitable industrial case studies for the validation in itself was a challenging task. Number of aspects had to be taken in to consideration by the author (1) through thorough examination of the nature of the case studies; (2) the challenges associated with each case; (3) the possibility of fulfilment of criteria which would suffice the validation process etc. Given the wholesome

nature of the Lean ERP implementation framework, ideally the author would take on a prominent lead role and corroborate each component and phase of the framework – initiating with the leanness assessment and finalising with the activities in Post go live support and maintenance, whilst taking in to account change management and OBEYA. Realistically this was not attainable; however, the author was able to locate two case studies both suitable and of a reputable nature.

In both cases, the organisations had initiated ERP implementation and had made some progression, the author was given the freedom to partake and engage with the team to study the challenges associated with each increment of the ERP implementation and used this as an ideal opportunity to present his suggestions based on the Lean ERP Implementation framework. Table 6-2 presents an overview of the components from the Lean ERP implementation framework with reference to the case studies.

Table 6-2: Lean ERP Framework components covered within the case studies

PHASE	OVERVIEW OF LEAN ERP IMPLEMENTATION FRAMEWORK COMPONENTS COVERED DURING VALIDATION	AREAS COVERED	
		CASE STUDY 1 (NHS)	CASE STUDY 2 (GOVERNMENT ORG.)
1	Leanness Assessment Model	✓ 18 Participant	✓ 6 Participant
2	OBEYA Room	✓ Introduce	✓ Modify
3	Kotter's Change Management	✓ Introduce	✓ Improve
4	Lean ERP Implementation framework: *Pre - Implementation Activities*	☒	✓
5	Lean ERP Implementation framework: *Phase 1* activities	✓	✓
6	Lean ERP Implementation framework: *Phase 2* activities	✓	✓
7	Lean ERP Implementation framework: *Phase 3* activities	✓	☒
8	Lean ERP Implementation framework: *Phase 4* activities	✓	✓
9	Lean ERP Implementation framework: *Phase 5* activities	✓	☒
10	Lean ERP Implementation framework: *Post – implementation & Maintenance activities*	☒	☒

It should be noted that the affirmation does not suggest under any circumstance that all the activities have been fulfilled in that particular phase, however it indicates a suitable fulfilment was achieved for example – Phase 3 is a highly complex part of the framework and accounts for more than 20 separate

activities, the affirmation in case study one suggests the author was able to validate major activities whereby a high level of influence and success was achieved.

6.3 Case Study (1): NHS trust

This section presents the first case study; it begins with providing an initial background to the case study company. Details of the leanness assessment and justification of its alterations, followed by a detailed explanation of the AS-IS with indications to the strengths and weaknesses. The ERP implementation initiative by the case company is discussed and the overall objectives are highlighted. The involvement of the author during the companies *'traditional'* ERP implementation initiative and the propositions (based on the lean ERP implementation framework) as a replacement of the typical activities and a means for enhancement and optimisation are discussed singularly. Whereby, each scenario/predicament is carefully examined and the lean proposition(s)/solution(s) are discussed followed by the obtained by the company are noted.

6.3.1 Case Study Background

The NHS trust was formed in April 2000 and currently employees 5000 personnel, upon average treating 600,000 patients annually with a yearly turn over of £381 million. The particular Trust selected for this case study is located in the Hertfordshire County Council and is currently operating four hospitals, of which the largest (the district general hospital) is the focus of this case study, the demographics and capacity of this hospital can hold up to 720 inpatients at one given time. Due to confidentially reasons the hospital will be referred to as "Case L" throughout the discussion.

The Information Technology department is a centralised shared service within the trust and is geographically located on site. The current standing CIO has been serving the NHS for 11 consecutive years and recently joined this trust in 2015, and has demonstrated a high level of interest in lean thinking and

principles and their direct benefits to be obtained through the conjoint use of IT in the betterment of patient care assistance and safety.

The introduction of large IT initiatives in the NHS can be dated back to 1992, with the introduction of strategies such as the Information Management and technology (IM&T), the primary principle still stands strong to date, which is: *promote the development of an information culture.* In 2002 an initiative known as the National Programme for IT (NPfIT) was undertaken; more than 12.5 billion pounds was spent

in the formation of the infrastructure and upgrading the existing legacy systems. This ambitious initiative posed major challenges and setbacks have already been foreseen, for example: a plan for a paperless NHS by 2018 was announced and later the due date was changed to 2020, which has now been further extended to 2023.

Secretary of State for Health, Jeremy Hunt MP for South West Surrey constituency stated in February 2016 as: *"Improving the standard of care patients receive even further means embracing technology and moving towards a fully digital and paperless NHS. NHS staff do incredible work every day and we must give them and patients the most up-to-date technology."*

6.3.2 Identifying the Current Status Via Leanness Assessment

One the distinguishing feature of the Lean ERP implementation framework is the leanness assessment which has been described throughout Chapters 4-6. The leanness assessment tool allows identifying the current (leanness) status of an organisation. The initial activity performed by the author was undertaking a session with three senior consultants (certified in Lean Six-Sigma) from the Digital Transformation Team at the organisation to review the leanness assessment model. The purpose of this session was to ensure the consultants gained familiarity with the mechanics of the model and its workings prior to dissemination amongst the staff for data collation. The generic nature of the model allows for the tailoring for specific audiences and this was experienced during the session, whereby the consultants suggested amendments of

terminologies, merger and introduction of new attributes. For example, the term “ERP Consultant” was replaced with “DT (Digital Transformation) Expert,” this would ensure the eradication of confusion with the consultant physician which is commonly used in hospitals.

Alterations were made to the model to ensure the presence of the researcher was eliminated during the completion of the model by the staff, as result the number of participants from the trust was maximised. It is important to state the technical elements of the model were left intact and no amendments took place. The three consultants also part-took in the completion of the modified leanness assessment model and initial results were calculated and generated to ensure no major issues arise as a result of the modifications. Having approved the modifications, the model (encapsulated in an Excel file) was distributed amongst the hospital staff – directly involved in the process of systems acquisition and implementation.

Based on the results generated from the assessment tool, the leanness index for system implementation process in Case L is 6 which is Lean. At first instance this level can be considered acceptable, taking in to consideration that the object of review is a hospital. However, these results indicate towards a number of inherent predicaments which are deeply rooted which call out for a further examination of the current state and room for further improvement and enhancement is evident and would be addresses as the progress of the ERP implementation would take place. This initial assessment allowed the author to selectively identify the major areas of concern, which would arise during the progression of the ERP implementation, these were discussed with the consultants, the concerns raised by the author we received positively with the team and were flagged up and enlisted within the OBEYA room (which was also designed by the author). The team was eager to resolve the occurrence of each predicament (identified from the assessment), it was suggested each predicament would be resolved in the correct manner and at the most suitable time.

6.3.3 Capturing the AS-IS: Case study examination and evaluation

NHS Digital on a national level conducts a digital maturity exercise; it reflects the digital capabilities available to organisations and the extent to which those capabilities are available and being optimised across the organisations as a whole. The case study trust came below average on 10 of the 14 return categories.

The local Borough Council developed a Local Digital Roadmap (LDR) with the participation of all health service providers within the borough. The main objective of the roadmap is to leverage the digital maturity of health services in the county through extensive collaboration between the providers and resource sharing approach.

In mid 2014, the trust developed a five year strategic plan which included performing a SWAT analysis and other management based theories, as a result the strengths and weaknesses identified are as follows:

Strengths:

- A stable management team with a track record of delivering complex and potentially contentious change
- Good local reputation and good links with local communities, media, councils, MPs etc.
- A wide range of specialist services e.g. Cancer Centre, plastics, ENT, renal and urological cancer
- Growing reputation for research and education which helps the trust attract high calibre staff

Weaknesses:

- Administrative processes and systems can be difficult to use – Market share only
- Potential lack of capacity to deal with scale and pace of change
- Limited resource and expertise to produce management information and business intelligence

- Geographical distance from trust, physical infrastructure and lack of control over site

6.3.4 ERP Implementation Initiative: an opportunity to validate the Lean framework

The trust created their Information Management and Technology (IM&T) strategy by the end of 2015 that cover the period till 2020. The main aim of the strategy is to guide the trust towards a coherent and integrated environment for managing and delivering technology and information in support of the trusts business goals. The IM&T strategy recognises the essential information needed to achieve the trust vision; it also takes into account the major milestones to be achieved in correspondence to the digital roadmap.

Some of the objectives of the strategy are to reduce operations costs and to deliver care in innovative and efficient ways. The IM&T strategy presented six main elements to help achieve its goals:

1. Improving Patient Care: by providing required information at the point of use which will transfer the trust into the mobile data age.

2. Hospital of Choice: by introducing a patient portal as a new digital interaction channel.

3. Delivering Digital Care: Through implementing enterprise system, that includes Electronic Patient Record, Electronic Prescribing, and others

4. Best of Class IM&T: By introduce a culture of continuous improvement

5. Fit for Now, Fit for the Future: through secure infrastructure that supports expansion

6. From Data to Decision Making: by creating clinical analysis services

To attain the vision of “A digital paperless Care Record by 2020”, the trust started a digital transformation programme (DTP) during the last quarter of 2015, and they contracted a consultancy team to manage the programme.

The DTP team is applying Lean methodology and Six Sigma tool in managing the different projects and activities. The progress of the DTP was slow due to mobilisation requirements in the start, furthermore legislative and monetary challenges assigned by the government caused further delays.

Currently there are three systems under ERP implementation; the first system is the electronic patient record system (Lorenzo). This system is part of the NPfIT and the main reason for the trust to place careful attention to this system was the implementation support and fund provided by NHS Digital. The trust is planning to establish Lorenzo as the foundation of the total ERP system and to build other modules and functionalities around it. The implementation started in the first quarter of 2016 and was planned to finish by April 2017 but this date has now been extended due to number of variables. This approach of selecting the system contradicts with one of the critical success factors mentioned in chapter two which is ERP selection criteria. Even when organisations face financial challenges, it is important not to undermine such important considerations.

Furthermore, the second system is a pharmacy stock control and ePrescribing system supplied by JAC; the selection of the system was done in June 2016. The implementation of the system was segregated in to two parts; the stock control module first followed by the ePrescribing module at a later stage. The implementation of the first module was planned to take six months and finish by January 2017 but the project manager was hired in November 2016 and as a result more setbacks were experienced.

The third system is a mobile clinical workflow platform, namely Nervecentre, this system provides clinicians access to information when and where needed. This system provides range of solutions; from clinical noting and handover to beds management and operates on all types of devices (PCs, tablets, and Mobile phones). The system was purchased in the last quarter of 2016 but the actual implementation did not start until early 2017 due to late decision on which implementation approach to follow. All three systems have been implemented in other NHS trusts previously with Lorenzo being the oldest.

The local digital roadmap recommended the use of an appropriate change management processes to ensure a successful IT delivery. The Trust was in no position to make a relevant selection and did not possess the technical knowledge to ensure its successful implementation and delivery. Having identified this as potential opportunity, based on the comprehensiveness of the lean ERP implementation of the framework, the author proposed the inbuilt Change Management component (which forms its primary base on Kotter's Change management, see Chapter 6, Section 3).

6.3.5 Validating the Lean ERP Implementation Framework

Extensive engagement and regular meetings through multiple medians such as technical workshops, face-to-face interviews, group discussions, observations, document review, multiple site visits, communication with external and internal stakeholders etc. allowed the author to gain a communal yet profound insight in to the ERP implementation initiative. The author's participation and engagement throughout the implementation stages was recorded in a document titled: Framework Validation Portfolio. This particular document was designed by the author as a means of detailing technical predicaments and providing constructive solutions which

draws upon the Lean ERP Implementation guidelines to provide specific solutions. The following sections are covered in the document:

Section 1: General information

- Issue Number: an individual numerical reference of the predicament/challenge
- Framework correspondence: a direct locus to the particular Phase and Activity of the Lean ERP Implementation Framework
- Task: overview of the directive being performed
- Predicament: brief description of the problem
- Intensity/frequency: overall rating and its direct impact on the business domain

› Issue addressed to the NHS team: indicating whether or not the team has been made aware of the directive

Table 6-3: Example of Section 1 of Learn ERP Implementation portfolio

Issue No:	*1*
Task:	*Segmentation of the project into three singular projects*
Predicament:	*Fragmented systems that require extra resources*
Intensity / Frequency:	*High - Entire project is affected*
Framework correspondence	*Phase 3, Activity 3.2*
Issue addressed to NHS team?	*Yes*

Section 2: Technical description

i. **Problem statement:** provides a detailed description of problem including its background, cause and effects.
ii. **Discussion on Failures:** denotes technical detailing's of failures including its root and the current methods/tool/techniques in place (if applicable)
iii. **Waste occurrence:** as a result of the problem what wastes are generated and what areas are effected (and to what extent)
iv. **Lean Solutions:** lean technical solution provided by the author (based on the lean thinking philosophy and principles) which ensures the activity been performed during the ERP implementation achieves maximum without generating much waste
v. **Acceptability by the Trust:** discussion on the acceptability of the trust in accepting, implementing and maintaining the lean solutions
vi. **Benefits obtained:** monitoring and recording the success of the implementation

Based on the Framework Validation Portfolio, the proceeding discussion presents 7 validators for the first case study.

VALIDATOR 1: CASE L *Issue no: 1*

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE: ***Phase 3, Activity 3.2***

PREDICAMENT:	Fragmented systems that require extra resources
TASK:	Segmentation of the project into three singular projects
INTENSITY / FREQUENCY:	High - Entire project is affected
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT

The trust is implementing three systems at the same time with three different project teams and project managers (Patients Record System, Clinical System, and Pharmacy System). The three groups are working in isolation and do not coordinate with each other and there is no synchronisation between projects resources and activities.

DISCUSSION ON FAILURES

• During the planning stage, the trust did not realise the need of integrating the three systems. The integration/ interfacing is essential to the success of the systems and requires closed coordination to standardise systems parameters and develop interface protocols. Introducing the integration at this stage will definitely cause some inevitable delay.

• Proceeding without a form of integration or interface between the systems will result in many issues to end users post implementation; data of patients will have to be entered in each system separately which will lead to high resistance to new systems.

WASTE OCCURRENCE

This situation resulted in more resources were used and more time will be needed to rectify the problem. Usually, system suppliers (vendors) are not in favour of interfaces with other systems especially when direct competitors are involved and in this case more time will be required. However, if a decision is taken to proceed in the implementation without integration then more waste (time, money, and functionality) will occur on the long run.

LEAN SOLUTIONS

The use of the lean tool OBEYA room at this stage will help in sharing the resources between the three projects and elevate coordination between teams, and eventually merge the singular teams into one collective team.

ACCEPTABILITY BY TRUST

The digital transformation director agreed to use the OBEYA room and allocated and asked the researcher to lead the setup of the room. A discussion started with the three vendors on the possibility to build the integration/interface and to assess the anticipated cost and time.

BENEFITS TO BE OBTAINED

Using the OBEYA room allowed the team to visualise the status of each project and its progress that in turn made sharing resources much easer and in some cases the individual himself initiated the offer of sharing. Although the building the interface protocols had some initial increase cost and time, but it did result in more saving during the post implementation phase.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-1: Lean ERP implementation portfolio: Case Study 1- Validator 1

VALIDATOR 2: CASE L *Issue no: 2*

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE: *Change Management*

PREDICAMENT:	Delay in decisions and risk of project delay
TASK:	Segmentation of the project into three singular projects
INTENSITY / FREQUENCY:	High
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT

Top management support is one of the key critical success factors in ERP implementation and digital transformation. In the case study L, top management (CEO and CIO) do not show up regularly within the digital transformation team site.

DISCUSSION ON FAILURES

In strategic projects like digital transformation the role of top management is very crucial; passive support and low priority to the project are strong reasons for failure. The board of the trust has a dashboard with many operational KPIs that are monitored and discussed monthly in a meeting. However, none of these KPIs is linked to any element in the digital transformation programme; this result in the management lacking the update on the progress and hence delays in taking immediate actions.

WASTE OCCURRENCE

When major projects lack top management support time over run will take place and in this specific case these delays caused extra cost.

LEAN SOLUTIONS

Senior management need to show ownership for all projects within the DTP and participate with the team by attending stand up meetings in OBEYA rooms at least twice a week. Visiting the DTP offices (Gemba Walk) allows the management to visualise performance and progress and to help the team making corrective measures on the spot.

ACCEPTABILITY BY TRUST

This observation was discussed with DTP director and the CIO and the accepted the comment.

BENEFITS TO BE OBTAINED

The support of top management will put the DTP on the right track and will create a success story for other NHS trusts to learn from.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-2 Lean ERP Implementation portfolio: Case Study 1- Validator 2

VALIDATOR 3: CASE L ***Issue no: 3***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE: *Change Management*

PREDICAMENT:	Complications that leads to deficiency in health service delivery
TASK:	No change management activities
INTENSITY / FREQUENCY:	High
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT
Although the local digital roadmap mentioned the use of a change management model, the hospital did not implement any formal change management approach. Plans of the DTP were not communicated well to the staff and patients, and no change strategy or change agents are in place.

DISCUSSION ON FAILURES
The complexity nature of the digital transformation programme with so many stakeholders (government bodies, suppliers, patients and employees) and the involved change in business processes will lead to chaos if not managed properly. The NHS keeps updating policies and procedures in order to meet the ever-increasing public requirements; if hospitals / trusts are not ready to handle such changing environment the will fail and will not be able to sustain.

WASTE OCCURRENCE
The lack of a proper change management plan will result in redoing unsuccessful tasks again and again.

LEAN SOLUTIONS
One of the lean principles is continuous improvement and since the only constant in the NHS nowadays is change, then NHS trust needs to maintain a change management strategy running at all times.

ACCEPTABILITY BY TRUST
The DTP started a change management programme based on Kotter's model as recommended in the framework.

BENEFITS TO BE OBTAINED
Applying a change management model within the trust reduce resistance to change and encourage employees to be part of the team and participate in driving the change. It will also make the organization ready for any disruptions that might take place.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-3 Lean ERP Implementation portfolio: Case Study 1- Validator 3

VALIDATOR 4: CASE L *Issue no: 4*

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE:

Phase 1, Activity 1.5 ***Phase 2, Activity 2.3*** ***Phase 2, Activity 2.4***

PREDICAMENT:	Stuck with a system that doesn't adhere to all the requirements
TASK:	Limited choice in vendors selection
INTENSITY / FREQUENCY:	Medium
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT
The electronic patient record system (Lorenzo) is known as the flagship of NPfIT, the system is developed by iSoft that is owned by CSC. NHS made central money available to trusts that chose to adopt Lorenzo; and this is the main driver behind selecting this system by the case study trust.

DISCUSSION ON FAILURES
The trust was under financial pressure that affected its selection criteria for the system, even though, some of the previous implementation of Lorenzo had many challenges off which number of national outages that affected all trusts using the system. The historical contractual issues between NHS and CSC could lead to the later dropping the system and trust facing difficulties with support.
The trust is planning to have Lorenzo as a base for its ERP solutions; this will create high risk to the trust due to the frequent outages and instability. .

WASTE OCCURRENCE
Dealing with an unstable vendor could lead to many defects in the service provisioning activities that cause disruptions to the flow of value. .

LEAN SOLUTIONS
Paying close attention to the implementation process and learning from previous experiences could help in achieving smooth and successful implementation.

ACCEPTABILITY BY TRUST
The DTP agreed to visit other trusts that implemented the system to learn from their experiences.

BENEFITS TO BE OBTAINED
Some real life instance organisations should take carefully assessed risks which take in to considerations all possible mitigation circumstances and the challenges associated with them if the benefits outweigh the deficiencies of the system. Based on technically developed guidelines and scientific assessment will ensure the correct decisions are made for the given time.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-4: Lean ERP Implementation portfolio: Case Study 1- Validator 4

VALIDATOR 5: CASE L ***Issue no: 5***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE: ***Phase 3, Activity 3.10***

PREDICAMENT:	Inconsistency and delay in providing services
TASK:	Shortage in business process documentation
INTENSITY / FREQUENCY:	Medium
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT
Some of the business processes are not well-documented and accessible to staff.

DISCUSSION ON FAILURES
Lack of proper documentation for business processes drives the employees to one of two options; go ask someone who has answers or design the system to the best of his/ her knowledge. Developing the ERP system without clear business processes documents will lead to incorrect functionality or wrong workflow..

WASTE OCCURRENCE
Missing business processes will lead to delays in software development and may cause defects in service provisioning.

LEAN SOLUTIONS
In case of the lack of business processes documentations, then the use of the OBEYA room will help in building the new business processes with the participation of all stakeholders

ACCEPTABILITY BY TRUST
The DTP started the documentation of the missing processes with the participation of the concerned business units.

BENEFITS TO BE OBTAINED
Developing and documenting business processes will streamline the application development activity and help in providing quality services.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-5 Lean ERP Implementation portfolio: Case Study 1- Validator 5

VALIDATOR 6: CASE L ***Issue no: 6***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE:

Phase 1, Activity 1.4 ***Phase 2, Activity 2.1*** ***Enabler***

PREDICAMENT:	Un productive environment and high resistance
TASK:	Non-engagement of Employees
INTENSITY / FREQUENCY:	High
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT
The involvement of employees in the DTP is very week within this trust and too much workload. No initiatives to engage staff in major projects and not encouraging them to come up with comments and feedbacks.

DISCUSSION ON FAILURES
Keeping employees under pressure and not involving them in the major decisions and undergoing projects is leading to disengagement and unhealthy environment. The current turnover of the employees is higher than the targeted figures of the trust's KPI.

WASTE OCCURRENCE
High turnover of employees means more new staff that require more time and training to understand the job, which is affecting the quality of services in the trust.

LEAN SOLUTIONS
The trust needs to motivate the team spirit among the employees by involving them more in the decision process and empowering them.

ACCEPTABILITY BY TRUST
Accepted by trust and Leanness assessment model results reflected the same results.

BENEFITS TO BE OBTAINED
Employees' involvement is a key factor to the success of any transformation programme or enterprise system implementation.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-6: Lean ERP Implementation portfolio: Case Study 1- Validator 6

VALIDATOR 7: CASE L ***Issue no: 7***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE:

Phase 3, Activity 3.16 ***Phase 4, Activity 4.2*** ***Enabler***

PREDICAMENT:	Increased system cost due to duplication
TASK:	Fragmented business processes- silos
INTENSITY / FREQUENCY:	High
ISSUE ADDRESSED TO NHS TEAM?	Yes

PROBLEM STATEMENT
All business processes in the hospital are built on department level (silos). When patients visit the hospital, they will be asked the same questions in each department they visit (Out patients, Emergency, Pharmacy etc.).

DISCUSSION ON FAILURES
If the ERP system is designed and implemented with this approach then this will lead unsatisfied patients because of the repetitions and long times wait. Employees will need more time as well to accomplish the job.

WASTE OCCURRENCE
The value will not flow and productivity of staff will be negatively impacted.

LEAN SOLUTIONS
Creating the flow of value is one of the key principles of lean; maintain this principle is essential

ACCEPTABILITY BY TRUST
Yes and many business process improvements took place.

BENEFITS TO BE OBTAINED
Considering a comprehensive business process will help in reaching an effective flow of value throughout the hospital, which will lead to higher productivity.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-7: Lean ERP Implementation portfolio: Case Study 1- Validator 7

6.4 Second Case Study Validation: Government Sector

The second case study selected for validation is a government department and will be referred to as Case P for confidentiality reasons throughout the discussion. The structure of the reporting is similar to the previous case, whereby the case background is presented, followed by a discussion of the leanness assessment. The AS-IS state is explained followed by a detailed discussion of the ERP implementation initiative. A selection of the relevant components of the framework for validation is sought and singular scenarios are presented as validator cases. The reason for selecting multiple case studies is to attest and assess the generalizability and flexibility of adaptation of the lean ERP implementation framework. Comparatively, the nature of the case study is somewhat similar to the previous case; however, the apparent differences are as follows:

(1) It is solely a government department, whereas Case L was partially governmental and privatised
(2) The plan of system capacity for Case L was both internal and external, reaching an approx. number of 600,000 users, whereas Case P is limited to its internal users of 8,500
(3) The mechanisms of ERP utilisation by the end users differ in both cases, in Case L the patients have direct access to the ERP system, whilst in the second case the input of the users is uploaded to a database which is eventually transferred to the ERP system

6.4.1 Case Study background

The UK's Government Digital Service (GDS) initiated a digital transformation program for all government departments in the late 2014, with the aim of technologically advancing these departments by enhancing existing platforms, developing standards, and upgrading IT services. Since it came in to affect, the case study organisation replaced two notable units: (1) the internal ICT team and (2) web and intranet team with a new Digital Service Department (DSD), which is currently serving geographically dispersed end users throughout the UK

The Case P started the digital transformation programme with the following objectives: (1) to help drive changes in digital adoption, (2) engagement with the public, (3) greater collaboration internally through agile digital tools and to (4) introduce continuous cultural change. As part of the transformation programme a group was assigned to replace the current traditional practices with an alternative agile methodology that is clear and repeatable.

The DSD operate a website which serves as a centralized platform through which legislations, regulations and other information related to the public domain is made available and is updated regularly. Moreover, the website serves an additional purpose, occasionally information/documents by the public are collected and recorded in a database which is then transferred over to the ERP system.

6.4.2 Conducting the Leanness Assessment to identify the current state

As per the previous case, a Leanness Assessment was conducted with a group to identify the current state of the DSD. The group consisted of individuals representing the different positions of the DSD, with experience ranging between 15-20 years. The assessment was conducted throughout the course of four weeks which consisted of a total number of 5 meetings and 2 workshops. Each meeting imitated with a lengthy presentation followed by a through discussion and a question and answer session. The participants were requested to complete the forms, some responded instantly and completed the forms within 30 minutes whilst others requested leverage and emailed the forms at later dates.

After combining the forms, the following results were generated:

6.4.3 Capturing the AS-IS and identifying an opportunity to validate the framework

Currently, the ERP system has three major modules; Finance, HR, and Workflow. The project started in the last quarter of 2015 with a total cost of 17.1

million GBP and planned to finish by first quarter of 2017 but have experienced minor delay due to some unclear requirements definitions.

The DSD operates a website which serves as a centralized platform through which legislations, regulations and other information related to the public domain is made available and is updated regularly. Moreover, the website serves an additional purpose, occasionally information/documents by the public are collected and recorded in a database which is then transferred over to the ERP system.

Strengths:

- Financial constraints are minimal allowing for a higher threshold of resource utilisation since project initiation
- Direct and indirect acquisition of talented and specialist individuals to form a successful and highly motivated team
- Started embracing new methods for communication improvement amongst different departments to break silos, however these are yet to mature

Weaknesses:

- No optimal deliverance of technical/functional requirements for remotely located end users, in respect to the common users
- Operating using primitive legacy systems which now require great effort and monetary commitment for upgrade

6.4.4 Validating the Lean ERP Implementation Framework

The document titled: *Framework Validation* Portfolio that is introduced and discussed in section 8.3.5 is used to capture information throughout the validation exercise of the second case study.

Based on the Framework Validation Portfolio, the proceeding discussion presents 4 validators for the second case study.

VALIDATOR 1: CASE P ***Issue no: 1***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE: ***Phase 3, Activity 3.1***

PREDICAMENT:	Excessive information security measures
TASK:	Dissatisfied end users due to delays and poor system performance
INTENSITY / FREQUENCY:	High – common
ISSUE ADDRESSED TO DSD TEAM?	Yes

PROBLEM STATEMENT
It has been observed that information security is a subject for debates and arguments in all IT systems implementations within the DSD. This issue is present during the implementation phase and at system cutover time.

DISCUSSION ON FAILURES
The information security specialists exaggerate in defining the requirements which lead to long discussions and negotiations to approve the final requirement's document. Usually, applying information security requirements leads to excess use of firewalls and other security measures, which cause slow performance system and poor response on some operating systems.

WASTE OCCURRENCE
- During project imitation and requirements definitions too much time is wasted in discussion (on agreement of security issues) between the different business departments, and this is repeated in every project.
- Day to day activities are hindered due to valuable time been lost – whilst more effort is placed on resolving technical security issues

LEAN SOLUTIONS
The Information security personnel should work in conjunction with the relevant representatives of business departments to generate a generic rule of thumb which is simple, effective and feasible for each project.

ACCEPTABILITY BY DSD
The organisation have taken on board the lean solution and will implement it at the start of the next project which is timed to begin in early June 2017.

BENEFITS TO BE OBTAINED
Reduction in time and smooth flow of the implementation

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-8 Lean ERP Implementation portfolios: Case Study P- Validator 1

VALIDATOR 2: CASE P ***Issue no: 2***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE:

PREDICAMENT:	Continuous changes in requirements causes system instability and more training needs
TASK:	High turnover in end-users result in many change requests
INTENSITY / FREQUENCY:	Medium
ISSUE ADDRESSED TO DSD TEAM?	Yes

PROBLEM STATEMENT
The nature of work at this organisation require a frequent change in staff from the core business; it takes place on a large scale every five years and sometimes it happen with major policy change. The digital services team is required to cater for the new requirements as well as

DISCUSSION ON FAILURES
This challenge is inevitable in this case study and it is adding volatility to ERP implementation and reflects the impression that the ERP system is not satisfying the required functionalities and consider it a failed implementation. This turnover in end-users creates an endless need for training as well as the necessity to update the training material to cover the changes.

WASTE OCCURRENCE
The major waste is the time of the resources required to update the system and training material. Redoing of work is another form of waste, and in the cases were major changes are required enormous cost will be involved.

LEAN SOLUTIONS
Creating well and documented standardized processes will help eliminating unnecessary change requests, and make training of new staff easy and fast.
Using value stream mapping tool by tracking lead time metrics during previous changes, will help in determining impact of any changes that may take place.

ACCEPTABILITY BY TRUST
The DSD team accepted the idea of VSM but they argued that current time is not appropriate to start this initiative and they might consider it after the start of the new fiscal year which is April 2017.

BENEFITS TO BE OBTAINED
A good reduction in cost and time is expected by addressing this issue in an effective way.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-9 Lean ERP Implementation portfolios: Case Study P- Validator 2

VALIDATOR 3: CASE P ***Issue no: 3***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE:

PREDICAMENT:	Complex transformation could end in a chaos
TASK:	Lack of proper change management programme
INTENSITY / FREQUENCY:	High
ISSUE ADDRESSED TO DSD TEAM?	Yes

PROBLEM STATEMENT
The volume of planned change in Case P is enormous; it includes the implementation of a new enterprise system and the migration and consolidation of over 150 applications. The DSD team stated that they do have change management programme in place, however, the researcher did not observe clear signs for change initiatives and there are many critical applications still run on legacy systems.

DISCUSSION ON FAILURES
Case P is implementing ERP system and carrying out a major digital transformation programme. The absence of clear and effective change management initiatives could lead to a chaotic situation and business disruption.

WASTE OCCURRENCE
Time over run and excess cost are expected to occur with the lack of a clear and effective change management programme.

LEAN SOLUTIONS
The researcher recommends having a well-designed change management programme that has the full support of top management and dedicated resources. A profound communication plan and active involvement from top management are key t the success of change management initiatives.

ACCEPTABILITY BY TRUST
DSD team accepted the recommendation and started to revisit their current change management initiatives with the involvement of the researcher.

BENEFITS TO BE OBTAINED
A more controlled and successful project are some of the expected benefits of having a change management programme

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-10 Lean ERP Implementation portfolios: Case Study P- Validator 3

VALIDATOR 4: CASE P ***Issue no: 4***

LEAN ERP IMPLEMENTATION FRAMEWORK CORRESPONDENCE:

PREDICAMENT:	Inefficient utilisation of the limited resources and projects conflicts.
TASK:	Too many projects running simultaneously with inadequate coordination
INTENSITY / FREQUENCY:	Medium
ISSUE ADDRESSED TO DSD TEAM?	Yes

PROBLEM STATEMENT

The researcher observed the presence of a project room that has some of the Obeya room concept. The status of most of the projects are presented on the walls, however, the room is under utilised and not updated frequently.

DISCUSSION ON FAILURES

Running large number of projects at the same time with aggressive plans and limited resources usually leads to missing deadlines and additional cost, when lacking solid and close coordination

WASTE OCCURRENCE

The possible wastes to take place are: Over processing through redundancy, and delays due to unnecessary distractions and interruptions

LEAN SOLUTIONS

The researcher recommended to redesign the room and proposed a new layout and modified guidelines on the best utilization and frequency of use the room.

ACCEPTABILITY BY TRUST

When the proposal discussed with the DSD team, they accepted the concept and liked the approach. The researcher was not able to observe the implementation of the recommendation due to time constrains.

BENEFITS TO BE OBTAINED

The use of Obeya room stimulates thorough collaboration and builds mutual trust between teams. The visual presentation aspect of Obeya allows intercepting problems as soon as they appear, and team members can then solve them at the right time.

LESSONS LEARNT FOR FUTURE DEVELOPMENT OF THE LEAN ERP IMPLEMENTATION FRAMEWORK

Figure 6-11 Lean ERP Implementation portfolio: Case Study P- Validator 4

6.5 Validating framework through expert opinion

Validation through expert judgement and opinion provides a personal and direct review as opposed to case studies, and multiple benefits are obtained through it. Complimentary to the case studies, the author was able to organise sessions to validate the lean ERP implementation framework with industry experts. The results recorded herewith denote the collective response, which has been organised based on the modules of the framework: Module 1: Leanness Assessment Model, Module 2a: Change Management, Module 2b: OBEYA, Module 3a: Implementation and Guidelines and Framework (as a whole).

a) Participants of Experts Validation

A number of validation sessions were conducted with some industrial experts across different organisations types; end user, consultant, and vendors. Table (6-4) shows the list of participant experts with job titles and years of experience.

b) Results from validation with experts

Expert validation initiated with the author presenting the research in the form of a presentation and demonstration of the individual modules of the framework. The experts were requested to complete a questionnaire and provide a rating for each question from a scale of 1-10 as well as record their comments in the suggestions section. (See Appendix F) The proceeding discussion provides an arrangement of the results in both tabular and graphical form.

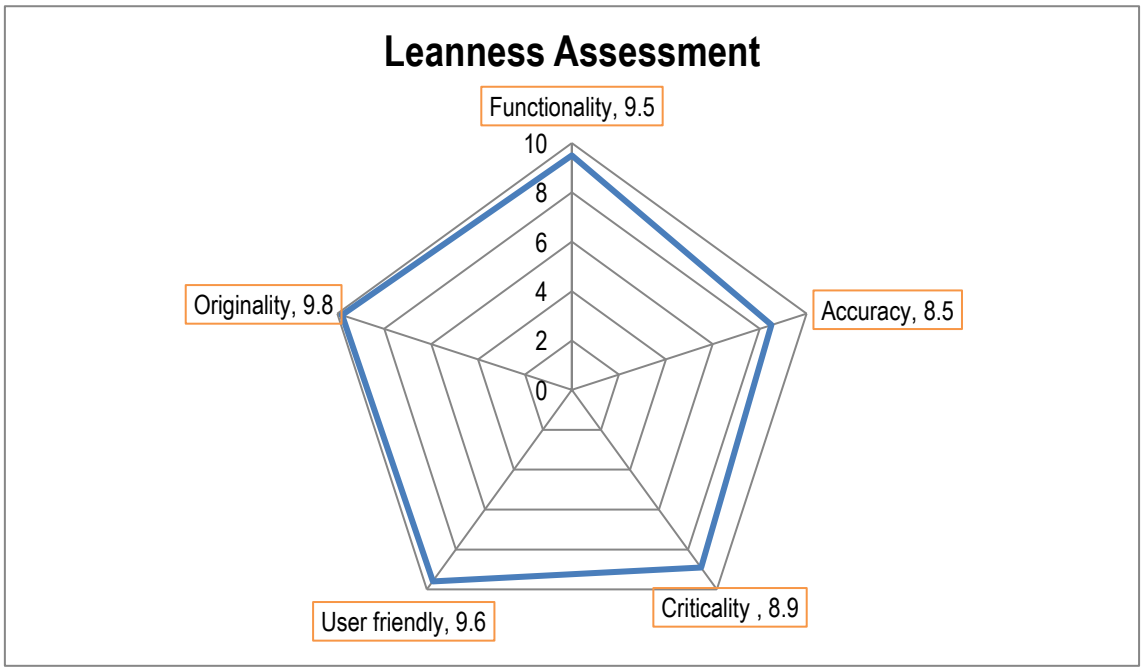
Table 6-4: List of participant experts

Expert Number	Organisation Type	Job Role	Experience (Years)
E 01	End user	Chief Information Officer	21
E 02	End user	Senior Project Manager	9
E 03	End user	Director of Projects	14
E 04	End user	Chief Technical Officer	18
E 05	Consultant	Lead Technologist	8
E 06	Consultant	Lean Six Sigma Change Consultant	6
E 07	Consultant	Digital Transformation Senior Consultant	13
E 08	Consultant	ERP & Software Principal Consultant	16
E 09	Consultant	Free Lance consultant	22
E 10	Vendor	Senior Services Account Manager	9
E 11	Vendor	Chief Operating Officer	15
E 12	Vendor	Senior Manager	11
E 13	Vendor	System Delivery Director	16
E 14	Vendor	VP Technical Support	19

Module 1: Leanness Assessment Model

No	Criteria	Ratings
1	**Functionality** *Please how do you see the functionality of the structure of the leanness assessment model and its main elements?*	9.5
2	**Accuracy** *How do you assess the accuracy of the results of leanness assessment model in reflecting the current status of the process / organisation?*	8.5
3	**Criticalities** *To what extent do you believe that the enablers and their elements considered critical for the successful implementation?*	8.9
4	**User-Friendliness** *Do you see the leanness assessment model as user friendly please?*	9.6
5	**Originality** *Do you consider the concept of the leanness assessment model original?*	9.8

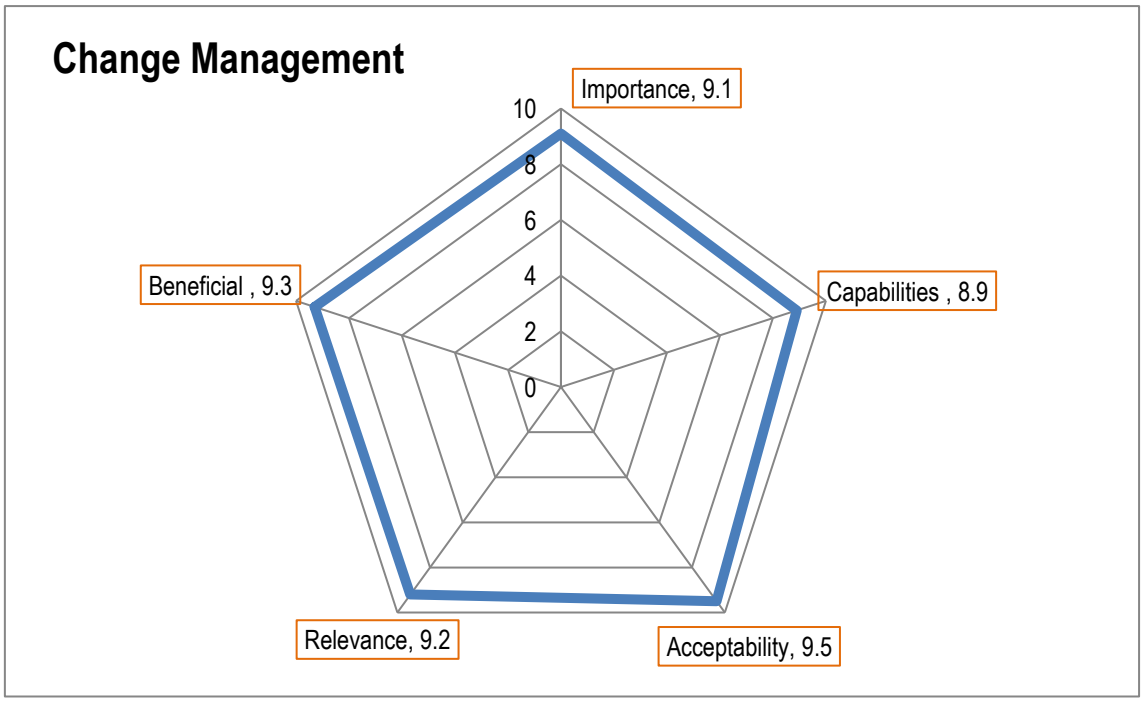
0 = total negation 10= complete affirmation



Module 2a: Change Management

0 = total negation 10= complete affirmation

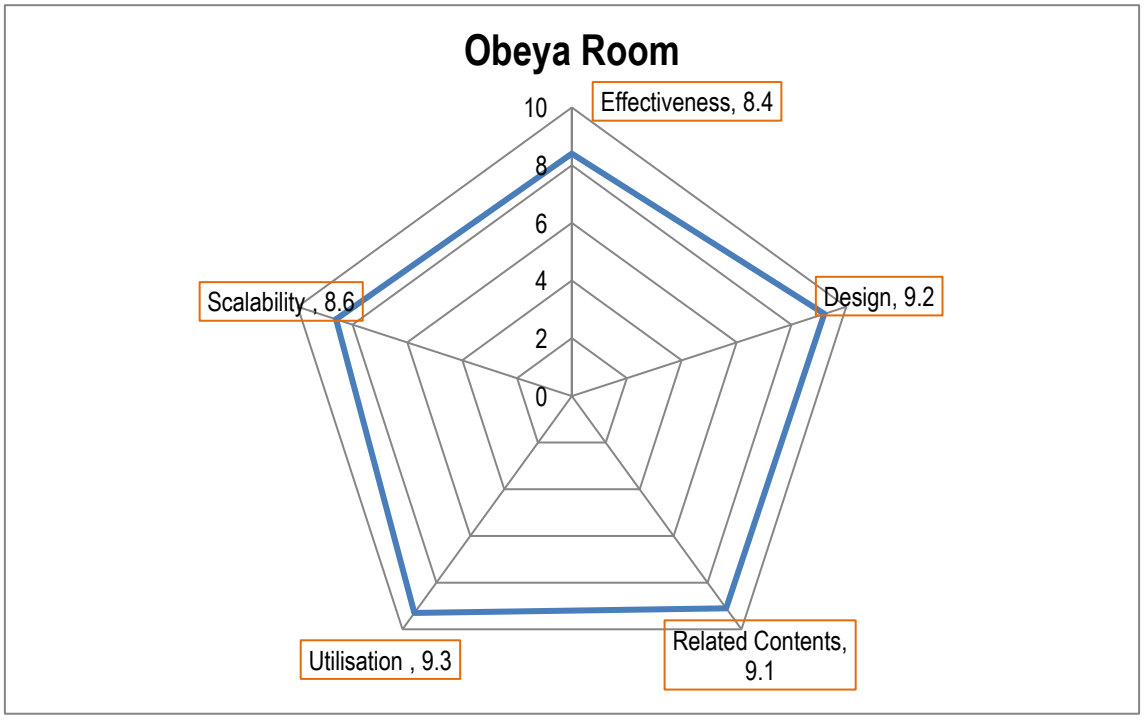
No	Criteria	Ratings
1	**Importance** *Please do you see it important to apply a change management model when implementing enterprise systems?*	9.1
2	**Capabilities** *How do you assess the capability of change management models to reduce resistance of staff to accept new systems and business processes?*	8.9
3	**Acceptability** *Do you see that applying change management approach is easily acceptable by top management please?*	9.5
4	**Relevance** *To what extent do you believe that the Kotter change model is relevant to enterprise systems implementation?*	9.2
5	**Beneficial** *Do you believe that the Kotter change model is beneficial to the success rate of enterprise systems implementation?*	9.3



Module 2b: OBEYA

0 = total negation 10= complete affirmation

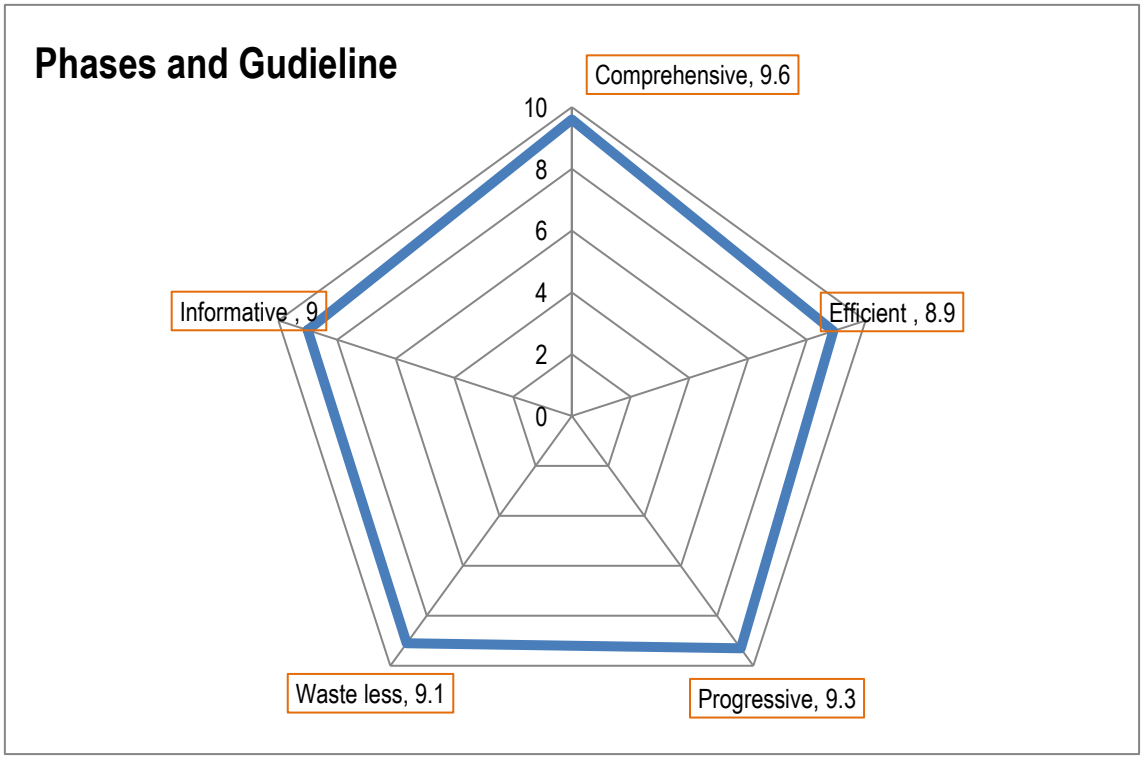
No	Criteria	Ratings
1	**Effectiveness** *How effective do you see the concept of Obeya room in managing enterprise systems implementation projects?*	8.4
2	**Design** *How do you evaluate the design and layout of the Obeya room?*	9.2
3	**Related Contents** *Do you see the content of the Obeya room in relation to project planning?*	9.1
4	**Utilisation** *To what extent do you believe that the implementation team will utilise the Obeya room?*	9.3
5	**Scalability** *Do you believe that the Obeya room is scalable to accommodate different sizes of implementation projects?*	8.6



Module 3a: Implementation and Guidelines

0 = total negation 10= complete affirmation

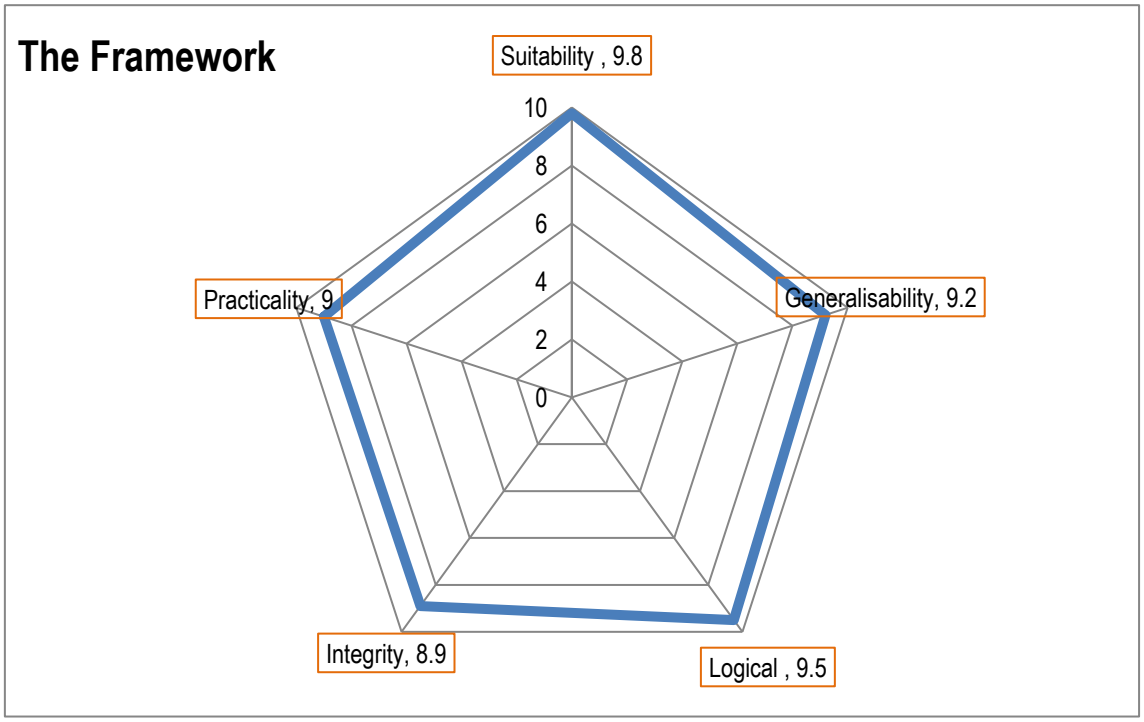
No	Criteria	Ratings
1	**Comprehensiveness** *How comprehensive do you see the proposed implementation activities and its guidelines?*	9.6
2	**Efficiency** *How do you assess the efficiency of the improved implementation activities?*	8.9
3	**Progressiveness** *To what extent do you see the proposed implementation process progressive and provide smooth transitions for enterprise systems implementation?*	9.3
4	**Waste-Less** *Do you believe that the proposed implementation process has addressed all possible waste and it could be considered as waste less?*	9.1
5	**Informative** *To what extent do you see the guidelines will be informative and will help in managing the implementation process?*	9



Module 3b: Framework (as a whole)

0 = total negation 10= complete affirmation

No	Criteria	Ratings
1	**Suitability** *Is the framework suitable for managing enterprise system implementation?*	9.8
2	**Generalizability** *Please evaluate the applicability of the framework to be used with other major IT projects (*	9.2
3	**Logical** *How do you assess the logic of the framework please?*	9.5
4	**Integrity** *How do you appraise the integrity of the framework with the whole Implementation life cycle?*	8.9
5	**Practicality** *In your opinion, does the developed lean based framework provide a practical approach in managing enterprise systems implementation?*	9



6.6 Summary

The framework development has been a prolonged process that involved reviewing the literature on multiple subjects, running surveys, and conducting interviews with expert from academia and industry. To assess the usefulness and usability of the proposed framework, a form of validation ids required. In this research, the framework is validated using case study approach and experts validations.

Case study strategy helps understanding complex sociotechnical phenomena; the strategy is particularly effective with modern real-life context situations (Yin, 1994). Furthermore, the framework validation by industry experts required the design of a questionnaire that is divided into three parts (coy of questionnaire in Appendix F):

- Introduction to the framework through a 10 minutes presentation to describe the aims of the framework and gives an overview of the framework as a whole.
- Key validation questions, which is the main part of the questionnaire that presents the key concepts of the framework.
- The final part that is the general validation questions that presents open-ended questions to provide opinion on the framework as a whole.

The validation of the lean ERP implementation framework is conducted with two UK based case studies; one of them is an NHS trust and the other is a government department. However, it was not possible to validate the whole concept of the framework due to time limitation because the average ERP implementation time is 18 months.

Both case studies had digital transformation programmes running at the time of the research, which formed an excellent opportunity for the researcher to be part of the dynamic environment with multi projects running at the same time. The different types of businesses of the cases studies and the diverse approaches used, added more enrichments to the validation process.

One of the critical initiatives at the NHS trust was to improve the ambulance handover time and meet the targets sat by NHS England. The project involved system replacement and business process reengineering, which was a good case to test the framework. The team at the trust achieved exceptional success and transformed the hospital from being the worst performer in the region to the best, the trust was not able to meet the targets of ambulance handover time for more than three years. Two month later, the team successfully implemented a healthcare ERP system (Lorenzo), which is used by many NHS trusts around the country. Appendix (E) shows copies of the press releases issued by the trust at the time and copy of a LinkedIn post thanking the researcher for his involvement.

The second case study is with a government department which running number of projects to enhance their digital capabilities and presence on the eservices platform. There is a low level of interaction with the public and most of the work is focus on improving the workflows within the organisation through implementing a new ERP system in addition to a knowledge management system. The researcher noticed that the organisation is partially applying the concept of Obeya although they were not calling it the same name.

To farther enhance the validation of the framework, 14 industry experts agreed to participate in workshops to provide their feedbacks and assessment. Experts were requested to evaluate their evaluation for each part of the framework and the framework as a whole using number of assessment criteria in each case. The criteria for assessing the framework are Suitability, Generalisability, Logical, Integrity, and Practicality, the overall feedback on the framework is good.

This research has been successful in contributing to knowledge in a number of avenues, which are as follows:

1. Uniformity in the understanding of critical success factors which resulted in the development of a leanness assessment model, which is to be used by organisations to gain an understanding of their state.

2. Identification and prescription of lean tools and techniques to the relevant activities in the ERP implementation process
3. Development of a novel framework that ensures a successful and optimal ERP implementation is achieved in a lean manner: giving essential attention to change management to ensure a smooth transition, lean attitude to ensure waste is kept to a minimal and mistakes are addressed proactively and utilisation of Obeya to communicate concurrently the progress of the implementation and manage risks in the most effective manner
4. Development of high level guidelines based on the individual modules of the framework that provide adequate explanation and guidance throughout the progressive stages of the implementation (See Appendix G for a sample)

Chapter 7

DISCUSSION AND CONCLUSIONS

7.1 Introduction

The research presented in this thesis aimed to develop a novel framework based on lean principles and tools to be employed during ERP implementation process as a means of optimising the experience. This was successfully achieved by engaging in a number of sequential activities, which initiated with an in-depth academic investigation to identify the current status of ERP implementation processes and sought ways to go beyond such approaches by adopting lean thinking and principles. This was then further developed by conducting an industrial field study, whereby the author engaged with industrial practitioners to capture the current practices and opinions on enhancing ERP implementation using lean tools and techniques. The final activity was concerned with the developmental aspects of the research, the framework and its individual modules were developed some of which were a product of collaboration with industrial practitioners such as the assessment tool.

The ultimate goal for the research was the development of the framework, which is accomplished four major units namely Leanness Assessment, Change Management, Obeya, and Implementation. The framework was designed and constructed with the following criteria in mind: (1) Significance, (2) Approach, and (3) Effectiveness.

1) Significance:

The validation of lean ERP implementation framework has demonstrated that many benefits can be obtained through its utilisation, which includes minimising waste and increasing value. The first step of the framework is the assessment of the organisation's readiness for ERP implementation, which entails proactive measures to mitigate potential risks. The framework emphasis on

communication, by establishing OBEYA as a fundamental module the grey zone is eliminated and engagement across the team is achieved. Most of the times change management importance is underestimated, and incorporating it as an essential part of the framework influence organisation to implement it. This research builds its inner mechanisms on adopting and transposing lean principles, tools and techniques, as demonstrated in the scientific literature review this area is lacking research. This framework is an introductory piece of research, which has been developed through academic rigour and industrial input.

2) Approach:

A thorough examination of the framework reveals that it adheres to its primary specifications. The framework is intended to be used practically; therefore, complete reliance on theoretical constructs would overlook the challenges encountered during the implementation. Synergistically, the author was able to incrementally develop the theory as well as engage with industry in the frameworks construction and development to ensure a feasible and practical framework (and its individual elements) are erected.

3) Effectiveness:

The validation of the framework has demonstrated its effectiveness, providing the execution of activities as prescribed. The criteria of effectiveness can be fully evaluated with quantifiable examinations, however due to time restrictions this was made not possible. It is sufficient to state the framework is far more effective as opposed to traditional approaches as it forces individuals to make decisions of forth coming activities whilst ensuring associated risks/mistakes/wastes are carefully identified and minimised. The principle aim of adopting lean principles for ERP implementation is waste elimination through the control and efficient use of resources. For example, in order to minimise rework (due to programming issues) the concurrent use of OBEYA, change management, standardisation and value stream mapping are utilised. This theme is prevalent throughout the framework.

The validation of the framework is done with two approaches; case studies and experts' opinion. The two cases are in the UK, where partial validation of the framework was conducted at each case due to time limitations. Furthermore, fourteen experts, from different industries, participated in the experts' opinion workshops. The quality of the feedback and the acceptance level reflects the applicability and practicality of the framework.

The demonstrations of the Lean ERP implementation framework and its overall findings have been detailed in Chapter 7. It is in the interest of this chapter to present the following:

Having introduced the chapter in Section 7.1, a detailed discussion of the key findings is presented in Section 7.2. The contributions made by this research are listed in Section 7.3, followed by a discussion on the fulfilment of research objectives in section 7.4. In Section 7.5 conclusions are drawn, and the research limitations are presented in section 7.6. Finally, the suggestions for future research are addressed in section 7.7.

7.2 Discussion of Key Research Findings

This section presents the key annotations and an overview of the research findings considering the work performed throughout this thesis. The topics of the section are staged in a logical sequence as follow: literature review, research methodology, ERP implantations challenges, Applying Lean thinking to IT projects, Framework Development, readiness assessment model, and framework validation

7.2.1 Literature Review

To build a profound understanding of the research topic, the literature review explored three key leading research areas including; ERP implantations, Project and change management, and Lean principles and applications.

The subject of ERP implementation and the challenges that face practitioners have been addressed extensively in the literature. The critical success factors (CSFs) for ERP implementation have been greatly covered, where some papers

are very specific in nature that it discusses single factor and study its impact on ERP implementation process or one of the phases of the implementation. Other papers contemplate a collection of critical success factors (CSFs) and develop taxonomy to group the related ones based on diverse commonality factors. All of the papers suggest variable solutions and approaches to address the listed CSFs in the papers.

The literature on ERP implementation methodology could be classified into three main categories. The first group contains papers with developed conceptual frameworks or high-level generic approaches for ERP implementation, but rarely validated or applied. The second is papers that locked at ERP implementation phases and activities to study the associated costs benefits realisation, and the third has focused on implementation from a technical perspective only. The review of the literature also revealed that all major ERP solutions providers have their own implementation approaches that are internally developed to cover the specific needs of their solutions. Moreover, most ERP consultancy firms established implementation methodologies to help their clients along the project timeline. It is observed that most consultants and vendors do not cover the pre and post implementation phases in detail. Nonetheless, the need to develop more enhanced and comprehensive implementation methodologies / frameworks still exist as the failure rate of theses project still high.

Change management is the second topic addressed in relation to ERP implementation because of its substantial influence on the success of these projects. Change Management has been identified by many authors as one of the most important critical success factors for ERP implementation projects; however, it is not evidently included in many of the implementation approaches.

Previous literature renders diverse views on the different types of change models in general, and models' characteristics are necessary for ERP projects in specific. Some of the academic literature discussed the characteristics of the different change models and frameworks and they highlighted the applicability of each framework in the industry.

Number of change management models were investigated namely Kotter, Lewin, Bridge, ADKAR, and Mckinsey. The updated version of Kotter's 8 steps model (Accelerate) is selected because it is found to be the most compatible with the nature of ERP projects. Kotter model follows a step-by-step approach with very easy transition and agility that goes well with the different phases of ERP implementation. The review revealed that there is a lack of research that present an integrated change management model with an ERP implementation framework.

The focuses for the research in lean centred on lean transformation programs and how to successfully apply its principles. Many researches discuss the challenges of lean implementation and its critical success factors, and present some approaches and techniques that help organisations achieve their goals. The research on lean implementation provides recommendations on how organisations can adopt the principles of lean, and propose the lean tools and techniques that can be used to eliminate waste and increase value. And it is noticed that, during the last decade, there is an increasing number of researches in the area of assessing the leanness of organisations or processes. Also, it can be observed that there are a growing number of researches on the successful lean implementation in non-manufacturing sectors such as healthcare, construction, and information technology. It is perceived that there are number of researches which studied the application of lean principles on managing construction projects and on software development tasks. However, the researcher did not come across any papers that discuss the use of lean thinking in ERP implementation projects. The researcher identified another research gap which the lack of lean based framework that incorporate change management in it to manage ERP implementations.

7.2.2 The research methodology

The directive method followed by the author is mainly qualitative; its justificatory reasons are conferred in Chapter 3. Some precautionary measures are considered in order to minimise the inherent bias and possible validatory predicaments associated with this method. This was controlled by means of

considering multiple sources for data collection, conducting semi structured interviews and performing technical workshops, which provoked discussions for clarity on topics. As a supplementary method, quantitative methods were also utilised accordingly to collect first hand data and to reach more enhanced perception. In general, the deployment of different methods at the most applicable times and condition ensured the requirements pertaining to the given task(s) were successfully addressed. The author had broad interaction with ERP implementation experts as well as lean professionals in academic and industrial fields. This enabled the author to gather an understanding of applicability of lean thinking in ERP implementations and to build a general perspective of the possible lean tools and techniques.

Throughout the course of research, the author gained valuable experience and understanding, which allowed for the selection of methods and techniques most adequate to be employed. The main methods used in this research are surveys, experts' workshops, interviews, and case studies. The use of these methods is owed to their effectiveness in collecting qualitative information from experts. In addition, the author utilised some of the online applications such as LinkedIn and Meet Up to reach out to ERP and lean specialised groups. This helped in improving the participants' selection process and covering all possible stakeholders users, consultants and system vendors. To reduce researchers and participants' bias, interviews were done in groups and individually whenever possible, and summaries of meetings were sent back to individuals asking them to provide feedback and corrections to avoid misinterpretation.

Two groups of case studies were selected, the first one is to validate leanness assessment model while the second is used to validate the whole framework including the leanness model. The case studies are from different countries in Europe and the Middle East, and from different industries in public and privet sectors. It is sufficient to state the adopted research methodology depicted in Chapter 3 (figure 3-1) proved to be effective due to the flexible options within it.

7.2.3 ERP Implantation and Lean Awareness

Although ERP research extends for over five decades, the continuous development in IT systems and the ever-changing business environment exerts more challenges to ERP implementations. In addition to the reviewed literature, the author conducted web-based survey that was directed to ERP practitioners from different industries in many countries. The first outcome is confirming and ranking the most common critical success factors (CSFs) for ERP implementation. The top three factors reflect the perception of the practitioners on ERP implementations and emphasise the complexity of these projects. Secondly, most of the respondents (88%) assert the need for the development of a new ERP implementation methodology, which indicates that the available methodologies are not satisfactory. The third outcome is measuring the awareness level of ERP implementation practitioners with the lean principles and tools. The results indicate that there is moderate level of awareness with the lean tools, where the top three well-known tools are value stream mapping (VSM), KANBAN, and Kaizen. In the IT industry, some of the lean tools were introduced as a stand-alone tool and not within the lean context; this could be the reason for the popularity of some for them. Furthermore, three quarter of respondents believe it is possible to assimilate lean principles for improving ERP implementation processes. Overall, these findings are acceptable knowing that lean thinking is relatively new to the IT industry and started to be used in the last decade only.

7.2.4 ERP Challenges and Lean Enablers

The literature review reviled many similarities in the challenges and critical success factors for ERP implementation and lean transformation. The researcher studied the challenges of applying lean principles to manage ERP implementations and concluded that organisational readiness factor has great impact on the success of ERP implementations and lean transformations. The literature on leanness assessment and ERP readiness assessment formed the basis of identifying some enablers to be used in a leanness assessment model. The researcher started by shortlisting six enablers, and then validated these

enablers through workshops with 25 industry experts related to this field. The iterative process followed at the workshops resulted in adding, eliminating, rephrasing certain aspects of the presented contents developing the criteria and attributes lists. This exercise identified five enablers namely Leadership & Top Management, Business Process, Employees, Consultancy relationship and Vendors relationship.

The lack of literature in the area of applying lean principles to ERP implementations is one of the challenges faced by the researcher. The researcher noticed that ERP implementers and practitioners are eager for new implementation methodologies, which motivates the willingness to actively participate in providing feedbacks through workshops, open discussions, and surveys.

7.2.5 Leanness Assessment Model

Many scholars and practitioners affirm that assessing the organisation's readiness for ERP implementation is an essential step to mitigate associated risks of project failure. Scrutinising the researches, the author identified that most of the factors for measuring organisational readiness are similar to the factors of leanness assessment. These findings led to develop an assessment model, by combining concepts and methods from both areas, to measure ERP readiness with full perspective of lean thinking. The model is developed to be used by an organisation that is thinking of implementing an ERP system to help them identify their level of readiness and the areas that need improvement.

The identified five enablers form the first level of the developed model, which expanded to 18 criteria and 55 attributes as two successive levels. This model is then transferred into a tool using Excel sheets, which is designed with a user-friendly approach with features such as drop down menus and built in validation verification. To build a more accurate internal perspective on the status of the organisation, employees from all levels and different sectors within the organisation should populate the assessment tool. To minimise subjectivity and ambiguity that may arise from humans' judgement, fuzzy logic method is used in the calculation.

Before proceeding with developing the full framework, it deemed logical to examine and verify the efficacy of the model. A validation for the model was conducted with three case studies; an international oil and gas company in Europe, in addition to a telecom service provider and a government organisation in Saudi Arabia. Their ERP readiness is assessed and areas of improvement were identified, the three organisations are satisfied with the results and provided good feedback.

7.2.6 Lean Based ERP implantation Framework

The ultimate goal for the research was the development of the framework, which is accomplished four major units namely Leanness Assessment, Change Management, Obeya, and Implementation. The framework was designed and constructed with the following criteria in mind: (1) Significance, (2) Approach, and (3) Effectiveness.

1) Significance:

The validation of lean ERP implementation framework has demonstrated that many benefits can be obtained through its utilisation, which includes minimising waste and increasing value. The first step of the framework is the assessment of the organisation's readiness for ERP implementation, which entails proactive measures to mitigate potential risks. The framework emphasis on communication, by establishing OBEYA as a fundamental module the grey zone is eliminated and engagement across the team is achieved. Most of the times change management importance is underestimated, and incorporating it as an essential part of the framework influence organisation to implement it. This research builds its inner mechanisms on adopting and transposing lean principles, tools and techniques, as demonstrated in the scientific literature review this area is lacking research. This framework is an introductory piece of research, which has been developed through academic rigour and industrial input.

2) Approach:

A thorough examination of the framework reveals that it adheres to its primary specifications. The framework is intended to be used practically; therefore, complete reliance on theoretical constructs would overlook the challenges encountered during the implementation. Synergistically, the author was able to incrementally develop the theory as well as engage with industry in the frameworks construction and development to ensure a feasible and practical framework (and its individual elements) are erected.

3) Effectiveness:

The validation of the framework has demonstrated its effectiveness, providing the execution of activities as prescribed. The criteria of effectiveness can be fully evaluated with quantifiable examinations, however due to time restrictions this was made not possible. It is sufficient to state the framework is far more effective as opposed to traditional approaches as it forces individuals to make decisions of forth coming activities whilst ensuring associated risks/mistakes/wastes are carefully identified and minimised. The principle aim of adopting lean principles for ERP implementation is waste elimination through the control and efficient use of resources. For example, in order to minimise rework (due to programming issues) the concurrent use of OBEYA, change management, standardisation and value stream mapping are utilised. This theme is prevalent throughout the framework.

The validation of the framework is done with two approaches; case studies and experts' opinion. The two cases are in the UK, where partial validation of the framework was conducted at each case due to time limitations. Furthermore, fourteen experts, from different industries, participated in the experts' opinion workshops. The quality of the feedback and the acceptance level reflects the applicability and practicality of the framework.

7.3 Main Contribution to Knowledge

The most innovative and creative element in the ERP implementation framework is the adoption of lean principles, tools, and techniques and their utilisation for specific activities during the progression. The novelty of it

challenges existing paradigms through the introduction of leanness assessment model, change management, OBEYA and pre-post implementation activities as a fundamental element of the framework.

This research has been successful in contributing to knowledge in a number of avenues, which are as follows:

5. Uniformity in the understanding of critical success factors which resulted in the development of a leanness assessment model, which is to be used by organisations to gain an understanding of their state.
6. Identification and prescription of lean tools and techniques to the relevant activities in the ERP implementation process
7. Development of a novel framework that ensures a successful and optimal ERP implementation is achieved in a lean manner: giving essential attention to change management to ensure a smooth transition, lean attitude to ensure waste is kept to a minimal and mistakes are addressed proactively and utilisation of Obeya to communicate concurrently the progress of the implementation and manage risks in the most effective manner
8. Development of high level guidelines based on the individual modules of the framework that provide adequate explanation and guidance throughout the progressive stages of the implementation (See Appendix G for a sample)

7.4 Fulfilment of Research Objectives

Fundamentally, the purpose of this research constituted the development of a novel framework to enhance the ERP implementation process by means of lean tools and techniques. The methodological sequence and arrangement of activities in the framework ensures the pre-implementation, implementation and post-implementation aspects are taken in to account to ensure a smooth transition throughout the progression. The research consisted of five major objectives, which were considered elementary for the succession of the research; the individual fulfilment of these objectives is discussed below:

The first objective of the research was to explore and analyse the current ERP implementation processes as well as capturing the critical success factors for its

implementation – in order to identify and classify opportunities for improvement. This was successfully achieved and documented in the Chapter 2 of the thesis. This was made possible through a systemised review of scientific literature. A thorough analysis of the different ERP implementation processes academic and industrial alike were reviewed and key differences and similarities were identified for example a small percentage considered it obligatory to introduce pre-implementation activities prior to executing any further activities. In order to strengthen the study a more detailed comparative study was conducted which has been documented in Chapter 7**.** Furthermore, the critical success factors were identified and captured and were then used to form the inner mechanisms of the Leanness Assessment Model, which has been presented in Chapter 4.

The second and third objective was addressed successively from one another and was a result of multiple technical workshops with academics and industrial practitioners. The study consisted of four phases that helped to fulfil the requirements of the second objective and the third objective. The four stages of the study are as follows:

(1) Embryonic stage, which was concerned with developing the primitive ERP implementation process

(2) Progressive stage, which consisted on conducting a competitive analysis to confirm process maturity

(3) Assessment stage, which mapped the mature process using value stream mapping

(4) Enrichment stage, which focussed on assigning lean elements to the relevant associative activities

The fourth objective was to develop a complete and integral lean based framework for ERP implementation process that makes use of supportive tools and management methodologies. This was achieved by drawing upon the findings of the study enlisted above and rearranging the sequence of activities to ensure a technically viable and optimal implementation process is achieved. Furthermore, additional modules, which included making use of Obeya as a means of organising the progress of the implementation in a centralised

environment and Change Management principals, were synchronised to ensure an integral framework is developed.

The final objective of the research was to validate the lean ERP implementation framework through industrial cases and expert opinion. This was successfully achieved with two notable and reputable business cases and a group of experts, which have been discussed throughout chapter 8, and a more discussion has been presented above in Chapter 7.

7.5 Conclusions

Considering the results of research and the implications of findings, it can be concluded that the research has achieved its aim of developing a lean based framework for ERP implementation, and it also achieved all objectives that are stated in chapter three. Furthermore, the following conclusions can be drawn from the present research:

A. ERP implementation projects are complex and challenging, and there is a need for farther researches to develop new methods. Research on ERP implementation started in the 60's, still continuing, and more research will be required in the future. The rationale of the statement is the rapid development in ICT industry and the emergent innovations such as the cloud, Artificial Intelligence, and Big Data. Moreover, governments started enacting digital transformation programmes to their different departments and encouraging the privet sector to implement e-business solutions. The changing business environments, due to globalisation and competition, result in mergers and acquisitions, which necessitate the changing or upgrading of existing IT systems.
B. Although lean production started in the automobile manufacturing industry, its implementation has widely spread to almost all industries and business sectors. The information Technology sector is one of the latest sectors to assimilate lean thinking and applying it to different areas such as service disks and provisioning.
C. Introducing lean principles and tools in the development and components of the framework is original and an added value to ERP and lean

literature. Agile methodology initiated in the software development industry and its principles blend well with the principles of lean, which makes the framework more appealing to practitioners.

D. The validation revealed that practitioners and academics perceive the framework as practical and beneficial; in developing the framework, the author took into consideration the following aspects:
   1) The design and development of the framework followed theoretical and empirical approaches to be suitable for the current industry conditions.
   2) Unlike other implementation frameworks, the developed framework concentrates on all phases of the ERP lifecycle, and start from the time when organisation think of replacing or upgrading their systems.
   3) The assessment of organisation readiness for ERP in the first step, mitigate the risks and help organisations take proactive actions.
   4) The structure of the framework is designed with the intention to make the ERP implementation process leaner.

E. This research presents a comprehensive ERP implementation framework with high level guidelines that incorporate readiness assessment, change management, and lean principles. The framework can be described as adequately developed, integral, and justified through sound reasons and the full adherence to the research aim and objectives. Finally, this study focuses on ERP implementations, however, the findings may well be applied other systems and on a wider scope such as digital transformation programmes.

7.6 Research Limitations

Bias judgment is inevitable in researches with qualitative nature, and this research is no exception. The human interactions at case studies, workshops, and interviews could entail some influence of opinions for either party; this could disturb the reliability, validity, and replication of results. Some measures are taken to minimise the effect of this limitation, for example using multiple sources to collect data such as case studies, online surveys, and workshops. Leading

questions were avoided during the design of questionnaire and semi structured interviews. The sample size could be considered as a limitation which the author tried to balance by selecting case studies from different countries, different industries, and fro public and private sectors.

The framework is designed for managing major implementations at large enterprises. This limitation could lead implementers to avoid using it in small projects at large enterprises or in implementation projects at small and medium size companies. The author believes that the mounting digital transformation programs taking place around the globe along with lean implementation initiatives will require such comprehensive framework.

It was not possible to conduct a full validation for the framework at the case studies this is due to long duration for ERP implementation, which take 18 months on average. It is difficult to have enough time and to find an appropriate case study, however; the experts' validations partially compensate this limitation.

7.7 Suggestions for future research

Employing lean in ERP implementation framework is one of the identified research gap from the literature review; we hope this research will open doors for researchers to explore the area more. This section focuses on considering some of the potential future research areas, which might be helpful to enhance the research area.

- The lean ERP framework needs to be fully implemented at a representative organisation covering the whole lifecycle of the implementation. A typical case would be a large organisation that is in the early stage of thinking an ERP system; this will expose the framework to actual validation.
- It is recommended to test the framework with more organisations in the future, and involve organisations from all sectors and different industries. This point will enhance the framework's generalizability and fulfil the fundamental basics of testability.

- The leanness assessment model could be improved by revisiting its elements (Enablers, Criteria, and Attributes), and considering other methods than Fuzzy logic in the calculations.
- Adding a financial dimension to its enablers, such as cost analysis, could expand the leanness assessment model.
- Although the developed framework covered all stakeholders of ERP implementation, ERP on the cloud will entail the presence of hosting providers and different workflow. Thus, it is recommended to investigate the cloud ERP implementation and develop a framework that fulfils its requirements.

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APPENDICES

Appendix A: Questionnaire for awareness

This questionnaire is part of a PhD research project at Cranfield University. It is designed to investigate ERP implementation processes and there success factors, and to help in developing a framework using Lean principles to improve the ERP implementation success rates.

Survey results will be available for all participants at request, and all responses will be treated as confidential and anonymous to protect the respondent identity in any published data.

Should you have any questions about the study, please contact the researcher through the e-mail given below.
Thank you for your participation, your response really counts.

Adnan Alturkistani
Email: a.q.alturkistani@cranfield.ac.uk

***1. What type of industry do you currently work in?**

- ○ Manufacturing
- ○ Telecommunication
- ○ Retail
- ○ Consulting Business
- ○ Government Department
- ○ Other (please specify)

***2. In terms of ERP system, please indicate the role of your organisation?**

- ○ Consultant
- ○ System / Solution provider
- ○ End user
- ○ Other (please specify)

***3. What is your job role?**

- ○ Executive (CEO, CIO, CTO…etc.)

- ○ Management (GM, Director)
- ○ Project Manager
- ○ Other (please specify)

  [ ]

***4. Number of years of experience in current position?**

- ○ Less than 5 Year
- ○ 6-10 Years
- ○ 11-15 Years
- ○ Over 15 Years

***5. Number of years involved in ERP (or other systems) implementation?**

- ○ Less than 5 Years
- ○ 6 - 10 Years
- ○ 11- 15 Years
- ○ Over 15 Years

***6. How many large scale ERP (or other systems) implementation projects did you manage?**

- ○ None
- ○ 1 - 3 Projects
- ○ 4-6 Projects
- ○ 7-10 Projects
- ○ More than 10 Projects

***7. There are number of critical success factors in ERP implementation projects, following is a list of the most common factors. On a scale from 1-5, please indicate the importance of each factor with 5 being Very Important and 1 Not Important .**

	1 Not Important	2	3	4	5 Very Important
Top management support to the project.	○	○	○	○	○
Effective change management process.	○	○	○	○	○
Strong internal integration between departments.	○	○	○	○	○

Understanding of business implications and requirements.	○	○	○	○	○
Extent of system customisation.	○	○	○	○	○
The quality of data to be migrated.	○	○	○	○	○
Level and quality of training on system.	○	○	○	○	○
Alignment between IT and business departments.	○	○	○	○	○
Inclusive costs estimate for the project.	○	○	○	○	○

***8. How well do you agree/ disagree with the following statement:**
"There is a need to develop new methods and techniques to improve success rate of ERP implementation projects".

- ○ Strongly agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly Disagree

***9. From your experience, which of the following methods / techniques are used in IT project management?**
Select all that apply.

- ☐ Waterfall
- ☐ PMP
- ☐ ITIL
- ☐ Agile
- ☐ Scrum
- ☐ Prince2

Other (Please list)

***10. From your experience, who usually lead the ERP implementation project?**

- ○ Consultant

- ○ Vendor / Supplier
- ○ IT department / Customer
- ○ Other (please specify)

***11. Following is a list of lean tools, please indicate which ones you are aware of. Select all that apply.**

- ☐ Value Stream Mapping
- ☐ Kanban
- ☐ A3
- ☐ Kaizen
- ☐ 5S
- ☐ MUDA
- ☐ Obeya
- ☐ Gemba

***12. Please indicate to what extend do you agree / disagree with the following statement:**
"Usually, there are many iterations (repetitive work) and waste of time in all ERP implementation projects that could be eliminated if addressed properly".

- ○ Strongly Agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly Disagree

***13. Please indicate how much do you agree or disagree with the following statement:**
It is possible to apply Lean principles on ERP implementation project to improve results.

- ○ Strongly agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly Disagree

***14. The following lean tools are used in process improvement, please indicate how applicable each tool in improving ERP implementation.**

	Not Applicable	May be Applicable	Applicable
Value Stream Mapping	○	○	○
Kanban	○	○	○
A3	○	○	○
Kaizen	○	○	○
5S	○	○	○
MUDA	○	○	○
Obeya	○	○	○
Gemba	○	○	○

15. What is your name? (Optional)

16. If you like to receive a copy of the results, please provide your email address.

Done

Appendix B: Semi Structured interview

Semi Structured Interview

Introduction Part

- Express appreciation and thanks to participant for offering time and support.
- Explain research aim and objectives.
- State planed time for interview to be approximately 90 minutes.
- Confirm that all personal and company / organization information will be kept confidential and the researcher is responsible for confidentiality.

- Introduce the major topics to be discussed during the interview as follows:
    - The previous and current work experience and roles of the interviewee.
    - Perception of interviewee on ERP implementations success rate in Saudi Arabia.
    - The interviewee's opinion about main challenges of ERP implementations.
    - The interviewee's view on how and why these challenges are occurring, and how to overcome them.
    - The different methodologies and techniques used to mange ERP implementation projects, and how did it evolve in the past 10 years.
    - The interviewee's knowledge of Lean principles and tools and his point of view on the applicability of lean in improving ERP implementation projects.

Interview Questions

1. Could you please give a brief description about your current work and IT projects you are involved in?

2. Could you please shed some lights on your work experience and roles in regard to ERP implementation projects?

3. What are the criteria of a successful ERP implementations project?

4. What is your opinion on the success rate of ERP implementations in Saudi Arabia?

5. In your perception, what are the three most critical success factors of ERP implementation?

6. What is the current methodology used in managing ERP implementations projects?

7. How do you see the development in methodologies and techniques used to mange ERP implementations projects?

8. What do you know about Lean principles and tools?

If interviewee has little or no background about Lean, introduce Lean principles to him and then proceed to next questions.

9. Could Lean principles and tools be used to manage ERP implementations projects? If no then why?

10. Could you please identify any wastes in the ERP implementations process?

11. What Lean tools could be used to improve ERP implementations process?

12. Do you have any other comments please?

Interviewee's Information Form

Name:

Company / Organization:

Organization Business Area:

Job Title:

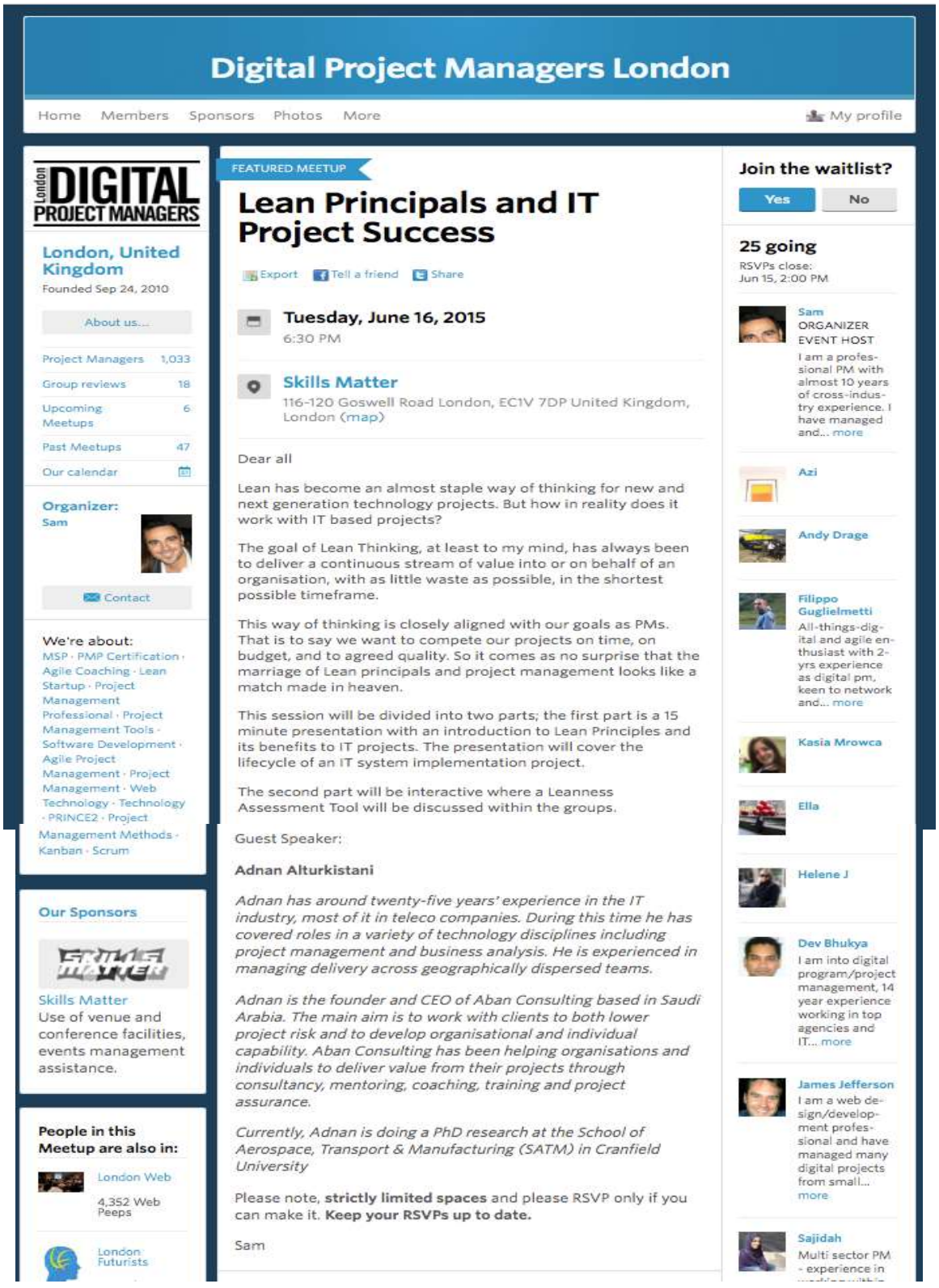
Qualification

Number of ERP projects involved in?

Current project and role:

Contact Info:

Appendix C: Invitation to MeetUp


Digital Project Managers London
Home Members Sponsors Photos More
My profile
London DIGITAL PROJECT MANAGERS
London, United Kingdom
Founded Sep 24, 2010
About us...
Project Managers 1,033
Group reviews 18
Upcoming Meetups 6
Past Meetups 47
Our calendar
Organizer:
Sam
Contact
We're about:
MSP · PMP Certification · Agile Coaching · Lean Startup · Project Management Professional · Project Management Tools · Software Development · Agile Project Management · Project Management · Web Technology · Technology · PRINCE2 · Project Management Methods · Kanban · Scrum
Our Sponsors
Skills Matter
Use of venue and conference facilities, events management assistance.
People in this Meetup are also in:
London Web
4,352 Web Peeps
London Futurists
FEATURED MEETUP
Lean Principals and IT Project Success
Export Tell a friend Share
Tuesday, June 16, 2015
6:30 PM
Skills Matter
116-120 Goswell Road London, EC1V 7DP United Kingdom, London (map)
Dear all
Lean has become an almost staple way of thinking for new and next generation technology projects. But how in reality does it work with IT based projects?
The goal of Lean Thinking, at least to my mind, has always been to deliver a continuous stream of value into or on behalf of an organisation, with as little waste as possible, in the shortest possible timeframe.
This way of thinking is closely aligned with our goals as PMs. That is to say we want to compete our projects on time, on budget, and to agreed quality. So it comes as no surprise that the marriage of Lean principals and project management looks like a match made in heaven.
This session will be divided into two parts; the first part is a 15 minute presentation with an introduction to Lean Principles and its benefits to IT projects. The presentation will cover the lifecycle of an IT system implementation project.
The second part will be interactive where a Leanness Assessment Tool will be discussed within the groups.
Guest Speaker:
Adnan Alturkistani
Adnan has around twenty-five years' experience in the IT industry, most of it in teleco companies. During this time he has covered roles in a variety of technology disciplines including project management and business analysis. He is experienced in managing delivery across geographically dispersed teams.
Adnan is the founder and CEO of Aban Consulting based in Saudi Arabia. The main aim is to work with clients to both lower project risk and to develop organisational and individual capability. Aban Consulting has been helping organisations and individuals to deliver value from their projects through consultancy, mentoring, coaching, training and project assurance.
Currently, Adnan is doing a PhD research at the School of Aerospace, Transport & Manufacturing (SATM) in Cranfield University
Please note, strictly limited spaces and please RSVP only if you can make it. Keep your RSVPs up to date.
Sam
Join the waitlist?
Yes No
25 going
RSVPs close:
Jun 15, 2:00 PM
Sam
ORGANIZER
EVENT HOST
I am a professional PM with almost 10 years of cross-industry experience. I have managed and... more
Azi
Andy Drage
Filippo Guglielmetti
All-things-digital and agile enthusiast with 2-yrs experience as digital pm, keen to network and... more
Kasia Mrowca
Ella
Helene J
Dev Bhukya
I am into digital program/project management, 14 year experience working in top agencies and IT... more
James Jefferson
I am a web design/development professional and have managed many digital projects from small... more
Sajidah
Multi sector PM - experience in

Appendix D: Questionnaire for meetup

Following is a list of criteria that are associated with the "Vendor Relationship" enabler.
For each criteria, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Vendor Leanness	○	○	○	○	○
Vendor Quality	○	○	○	○	○
Direct Supplier or Through Partner	○	○	○	○	○
Vendor Support	○	○	○	○	○
System Value	○	○	○	○	○

Following is a list of criteria that are associated with the "Consultancy Relationship" enabler.
For each criteria, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Experience of Consultancy Firm	○	○	○	○	○
Consultancy Leanness	○	○	○	○	○
Consultancy Improvement	○	○	○	○	○
Controls Measure	○	○	○	○	○

Following is a list of criteria that are associated with the "Business Processes" enabler.
For each criteria, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Process Optimisation	○	○	○	○	○
Process Flexibility	○	○	○	○	○
Process Streamlining	○	○	○	○	○
Process Improvement	○	○	○	○	○

Following is a list of criteria that are associated with the "Top Management Support" enabler.
For each criteria, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Management Practice	○	○	○	○	○
Leadership approach	○	○	○	○	○
Management Culture	○	○	○	○	○

Following is a list of criteria that are associated with the "Workforce Status" enabler.
For each criteria, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Workforce Services	○	○	○	○	○
Workforce Involvement	○	○	○	○	○
Workforce Culture	○	○	○	○	○

If you like to receive a copy of the results and the assessment tool, please provide your email address

A

What is your primary job title? (Please select one only)

- CIO/CTO
- Vice President
- Director
- Program Manager
- Project Manager
- Business Analyst
- Software Developer
- Supervisor
- Technical Consultant
- Other (please specify)
- Click to write Choice 11

What is the number of years in current position?

- Less than 5 Year
- 5-10 Years
- 11-15 Years
- Over 15 Year

What is the total number of years of experience?

- Less than 5 Year
- 5-10 Years
- 11-15 Years
- 16 - 20 Year
- 21 - 25 Year
- Over 25 Year

B

Following is a list of the main enablers that is believed to have impact on the success of ERP implementation.
For each enabler, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Strategic Readiness	○	○	○	○	○
ERP Vendor Relationship	○	○	○	○	○
Consultancy relationship	○	○	○	○	○
Business Processes	○	○	○	○	○
Top Management Leanness	○	○	○	○	○
Workforce Status	○	○	○	○	○

Following is a list of criteria that are associated with the "Strategic Readiness" enabler.
For each criteria, please indicates your opinion on its importance to your company

	Not Important	Less Important	Important	Very Important	Extremely Important
Structural Stability	○	○	○	○	○
Financial Aspects	○	○	○	○	○
Clear Plans for Products and Services	○	○	○	○	○

Appendix E: NHS case

Appendix E1 Ambulance

East and North Hertfordshire NHS Trust

E&NH0564

Ambulance handover times at the [redacted] now best in the region

Changes made at the hospital's emergency department see some 80% of ambulances now turned around within the overall national 30-minute standard, compared to around 10% previously

[redacted] ***UK – 4 July 2017*** – The majority of ambulances arriving at the [redacted] emergency now have their patients handover and ambulances ready to return to duty within 30 minutes of arriving. A new system, which was trialled in March 2017 and has been running since shows that the national turnaround standard is being achieved for over 80% of ambulances – which is the best performance in the East of England. Previously the [redacted] service saw between 10 to 15% of ambulances meet the standard.

When an ambulance arrives at A&E, there are two national standards that are expected to be met – the hospital team has 15-minutes in which to complete handover of the patient from the ambulance crew, who in turn have a further 15 minutes to get their vehicle ready to be deployed again.

The Trust's matron for the [redacted] emergency department, Kate [redacted], explains:

"With the help of colleagues in the Trust and the local ambulance service, we set about redesigning the handover process. The same steps are followed, but the sequence and how they are carried out has been changed to eliminate inefficiencies and wasted time. Trials were undertaken of the new process at the start of March, which showed very positive results and the system went live from 20 March 2017. Overnight, the Trust went from being pretty much the worst performer in the region to being the best. From 10% of ambulances being turned around within the overall 30-minute window, the new handover system saw that figure rise to 80% - where it has stayed ever since (and in some weeks, the team delivered the best performance in the country)."

Note: Names of hospital and staff have been shaded for confidentiality reasons

2/Ambulance handover times at the [redacted] now best in the region

Dave [redacted], deputy director of service delivery at the East of England Ambulance Service NHS Trust, added:

"We have worked with our colleagues for many months on improving the quality of service we are able to offer patients across Hertfordshire, and this is one great example of good collaborative working that has benefit to all agencies. If we are waiting to hand over our patients at the front doors of our local hospitals, then we are unable to respond to life-threatening 999 emergency calls in surrounding areas. I am very happy that the many months of work are now proving to have a real impact on patient safety and care".

The improved performance at the [redacted] has other benefits too – patients who were the most sick (e.g. suspected sepsis, stroke, cardiac and other acutely unwell people) are now being identified much more quickly, which means they are being seen by relevant specialist teams and treatment starting faster than before. For patients, their waits on trolleys have also been reduced significantly – which means a better overall experience for them.

The work on improving ambulance handover times at the [redacted] emergency department, including recent changes made to the initial triage/patient streaming systems, as well as how the next steps in someone's treatment are escalated more quickly once a decision is made to admit them or discharge them back home. Along with investment of an additional £600,000 funding announced by the Department of Health recently for further improvements to be made to the department's layout, the overall aim is to ensure that the service's improvement continues as it moves evr closer to meeting consistently the national A&E waiting time standard.

-ends-

Appendix E2: Trust

East and North Hertfordshire NHS Trust

E&NH0608

Trust prepares to roll-out new electronic patient record computer system

[redacted] ***UK – 7 September 2017*** – Friday, 8 September sees the Trust roll out its new electronic patient record computer system, which will replace an old service that needs to be replaced. The new system – called Lorenzo – will allow the Trust's staff to have improved access to information about their patients in real-time, which in turn will support clinical decisions being made more quickly. Recording of information relating to patients will also be made easier.

During the roll-out period, which will be from 8 to 11 September, the Trust's staff – who have been undertaking specialist training in how to use the new system for many weeks now – will be getting used to using Lorenzo whilst caring for their patients. Although the Trust has put very detailed plans in to place to help minimise disruption to patients, some may have longer waits to be seen during this period.

The Trust's chief executive, Nick [redacted], said:

"Introducing a new computerised system brings many challenges, which is why we have been planning for this roll-out for a long time. The plans that we are putting in place have been designed to minimise disruption in the launch of a system that has been tried and tested in other NHS hospitals across the country already. Whilst it may take our staff a while to get familiar with using Lorenzo in patient settings, we are hoping that any delays experienced by our patients will be kept to a minimum. We will be very grateful for their understanding and support over the next few days as the system is rolled out across the Trust."

Appendix E3: Post copy

Karen Cahn
Lean Six Sigma Coach at Open to new challenges - Member of NHS Improvement Di...
2mo

It has been a privilege and an honour to work with the ED team at East and North Herts, East of England Ambulance Service and their CCG. Great success for our bespoke methodology and coaching.
Dr Anna Bayes , Anita Saini , Alison Clare , Alison Taylor , Adnan Alturkistani

Adnan Alturkistani Glad to hear the great news Karen... your hard work has paid off.
The remarkable results at the ENH trust should be looked at as a "quantum success"; reaching 80% from 10% in a short period at a time where most NHS trusts are stumbling is quite an achievement. ...see more
2mo

Like Reply | 1 Like

Appendix F: Validation Questions

Framework Validation Questions

1. Leanness Assessment

1.1 Please how do you see the functionality of the structure of the leanness assessment model and its main elements?

1	2	3	4	5	6	7	8	9	10
Totally Unfunctional	Functional with major deficiencies				Functional with minor comments				Totally Functional

1.2 How do you assess the accuracy of the results of leanness assessment model in reflecting the current status of the process / organization?

1	2	3	4	5	6	7	8	9	10
Totally Not Accurate	Accurate with major deficiencies				Accurate with minor comments				Totally Accurate

1.3 To what extent do you believe that the enablers and their elements considered critical for the successful implementation?

1	2	3	4	5	6	7	8	9	10
Totally Uncritical	Critical with major deficiencies				Critical with minor comments				Totally Critical

1.4 Do you see the leanness assessment model as user friendly please?

1	2	3	4	5	6	7	8	9	10
Totally Unfriendly	Friendly with major deficiencies				Friendly with minor comments				Totally Friendly

1.5 Do you consider the concept of the leanness assessment model original?

1	2	3	4	5	6	7	8	9	10
Totally Unoriginal	Original with major deficiencies				Original with minor comments				Totally Original

2. Change Management

2.1 Please do you see it important to apply a change management model when implementing enterprise systems?

1	2	3	4	5	6	7	8	9	10
Totally Not Important	Important with major deficiencies				Important with minor comments				Totally Important

2.2 How do you assess the capability of change management models to reduce resistance of staff to accept new systems and business processes?

1	2	3	4	5	6	7	8	9	10
Totally Not Capable	Capable with major deficiencies				Capable with minor comments				Totally Capable

2.3 Do you see that applying change management approach is easily acceptable by top management please?

1	2	3	4	5	6	7	8	9	10
Totally Unacceptable	Acceptable with major deficiencies				Acceptable with minor comments				Totally Acceptable

2.4 To what extent do you believe that the Kotter change model is relevant to enterprise systems implementation?

1	2	3	4	5	6	7	8	9	10
Totally Irrelevant	Relevant with major deficiencies				Relevant with minor comments				Totally Relevant

2.5 Do you believe that the Kotter change model is beneficial to the success rate of enterprise systems implementation?

1	2	3	4	5	6	7	8	9	10
Totally Not Beneficial	Beneficial with major deficiencies				Beneficial with minor comments				Totally Beneficial

3. Obeya Room

3.1 How effective do you see the concept of Obeya room in managing enterprise systems implementation projects?

1	2	3	4	5	6	7	8	9	10
Totally Ineffective	Effective with major deficiencies				Effective with minor comments				Totally Effective

3.2 How do you evaluate the design and layout of the Obeya room?

1	2	3	4	5	6	7	8	9	10
Totally Not Good Design	Design has major deficiencies				Design has minor comments				Well Designed

3.3 Do you see the content of the Obeya room in relation to project planning?

1	2	3	4	5	6	7	8	9	10
Totally Unrelated	Related with major deficiencies				Related with minor comments				Totally Related

3.4 To what extent do you believe that the implementation team will utilise the Obeya room?

1	2	3	4	5	6	7	8	9	10
Will not Utilise	Utilised with major difficulties				Utilised with minor difficulties				Totally Utilised

3.5 Do you believe that the Obeya room is scalable to accommodate different sizes of implementation projects?

1	2	3	4	5	6	7	8	9	10
Totally Not Beneficial	Beneficial with major deficiencies				Beneficial with minor comments				Totally Beneficial

4. Implementation & Guidelines

4.1 How comprehensive do you see the proposed implementation activities and its guidelines?

1	2	3	4	5	6	7	8	9	10
Totally Not Practical	Practical with major deficiencies				Practical with minor comments				Totally Practical

4.2 How do you assess the efficiency of the improved implementation activities?

1	2	3	4	5	6	7	8	9	10
Totally Inefficient	Efficient with major deficiencies				Efficient with minor comments				Totally Efficient

4.3 To what extent do you see the proposed implementation process progressive and provide smooth transitions for enterprise systems implementation?

1	2	3	4	5	6	7	8	9	10
Totally Unprogressive	Progressive with major deficiencies				Progressive with minor comments				Totally Progressive

4.4 Do you believe that the proposed implementation process has addressed all possible waste and it could be considered as waste less?

1	2	3	4	5	6	7	8	9	10
Totally Wasteful	Waste less with major deficiencies				Waste less with minor comments				Totally Waste less

4.5 To what extent do you see the guidelines will be informative and will help in managing the implementation process?

1	2	3	4	5	6	7	8	9	10
Totally Not Informative	Informative with major deficiencies				Informative with minor comments				Totally Informative

5. Framework as a whole

5.1 Is the framework suitable for managing enterprise system implementation?

1	2	3	4	5	6	7	8	9	10
Totally Unsuitable	Suitable with major deficiencies				Suitable with minor comments				Totally Suitable

5.2 Please evaluate the applicability of the framework to be used with other major IT projects (Generalisability)

1	2	3	4	5	6	7	8	9	10
Totally Inapplicable	Applicable with major deficiencies				Applicable with minor comments				Totally applicable

5.3 How do you assess the logic of the framework please?

1	2	3	4	5	6	7	8	9	10
Totally Not Logical	Logical with major deficiencies				Logical with minor comments				Totally Logical

5.4 How do you appraise the integrity of the framework with the whole Implementation life cycle?

1	2	3	4	5	6	7	8	9	10
Totally Not Integral	Integral with major deficiencies				Integral with minor comments				Totally Integral

5.5 In your opinion, does the developed lean based framework provide a practical approach in managing enterprise systems implementation?

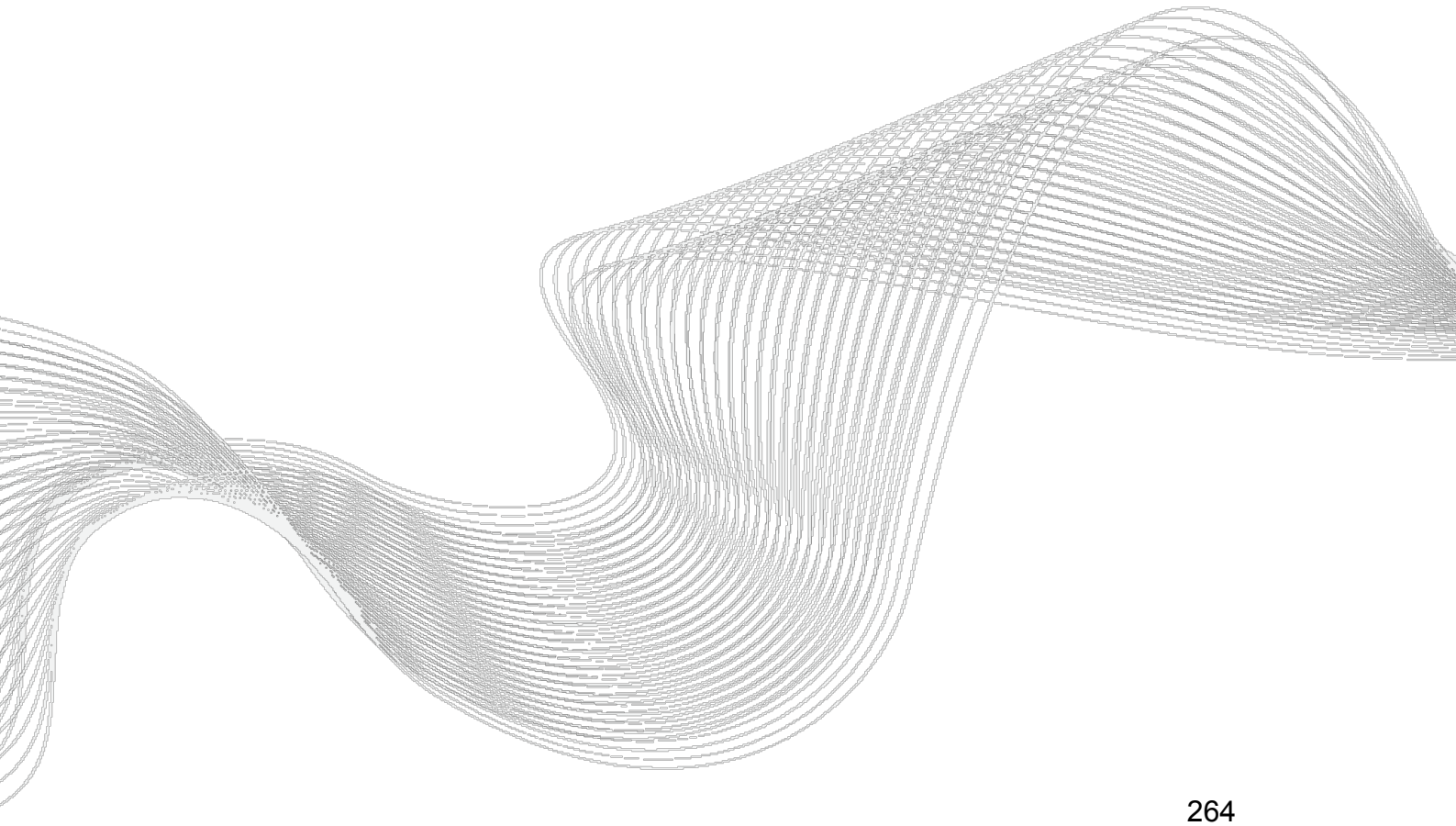
1	2	3	4	5	6	7	8	9	10
Totally Practical	Practical with major deficiencies				Practical with minor comments				Totally Practical

6. Please provide any comments about the framework you see viable and any other aspects do you see contributing to the successful use of lean thinking in the ERP implementation process.

Appendix G: Sample Guidelines

FRAMEWORK FOR A LEAN ERP IMPLEMENTATION

Guidelines



Foreword

Introductory text by the author

Adnan Alturkistani

Cranfield University

Contents

Phase 1: Needs Identification

The purpose of this phase is

1.1: Appointing the right consultant

"Appointing the right consultant will ensure you have an individual with the required skill sets and the technical know how to aid in making right decisions"

FACTS

This phase consists of X number of activities

WHAT YOU REQUIRE

In order to successfully complete the activities in this phase you are required to do the following

You may also consider utilising the following

WASTES

List here the Lean IT Wastes

LEAN TOOLS/TECHNIQUES TO UTILISE: Base your decision on careful assessment of the possible choices and have a conjoint consensus/agreement prior to selection. There is a factor of cost is involved: the cost of assigning a consultant is not anticipated well, most of the time the cost exceeds initial budget

LEAN RECOMMENDATION: from a business perspective wasting too much time on selecting the right consultant would not be favourable.

CAUTION: Possible Wastes that can occur

Define right: what is the criterion;

- Consultant who has experience (assess the years of ERP experience)
- experience in industrial sector (familiar with the workings of the sector
- Well acquainted with lean

Wastes to look out for: 1, 3 & 4

1.2: Define Project Motivation

"We must be in position to make the right decision and selecting the right option (it might be an upgrade or full re-wamp)"

XXXX

Add any additional information here what ever you feel is necessary

LEAN RECOMMENDATION: Genuine practical motive and not just to meet the trend; justifiable functional need.

CAUTION: Possible Wastes that can occur

XXX

Clear understanding of the project direction, scope, and expected outcome. Lack of clarity or failure to define the motivation will result in ambiguity from the beginning.

XXX

XXX

XXX

- The obvious waste is cost

Wastes to look out for: 2

XXX

XXXXXXXXXXXXXX

1.3: Feasibility Study

"To consider all the aspects of project i.e. how feasible is it financially and from a business perspective."

XXXXXXXXXXXXXX

XXXXXXXXXXXXXX

LEAN TOOLS/TECHNIQUES TO UTILISE: Trade off curves, Cost analysis

LEAN RECOMMENDATION: To conduct a thorough analysis of possible/feasible options and base the selection on a trade-off between cost and benefits

CAUTION: Possible Wastes that can occur

Through analysis of pros and cons and identifying the return of investment.

Wastes to look out for: 1 (miscalculations)

XXXX

Add any additional information here what ever you feel is necessary

XXX

XXX

XXX

XXX

XXX

XXXXXXXXXXXXXXX

XXXXXXXXXXXXXXX

XXXXXXXXXXXXXXX

1.4: Initiate Change Management

"Preparing the business environment for the expected resistance and to have the correct level of engagement from employees and stakeholders."

LEAN RECOMMENDATION: not engaging the employees will cause them to become disheartened and loose trust which will intact affect their day to day activities. It is therefore essential to engage with them to maintain a positive attitude and retain a positive atmosphere (prevent resistance to change)

CAUTION: Possible Wastes that can occur

Failure to initiate change management at the correct time and using the correct medians (i.e. informing the employees/stakeholders)

Wastes to look out for: 4

1.5: Pre-Invitation Screening & launch RFPs

"Pre-qualifying the vendors based on certain criteria prior to invitation of quotation & Sending a formal document to the vendors inviting them to submit the proposals."

LEAN TOOLS/TECHNIQUES TO UTILISE: Benchmarking, Review testimonials from previous initiatives of the vendor, Site visits of previous implementation of vendors

LEAN RECOMMENDATION: (1) the vendor has implemented in similar industry, (2) the vendor has a positive reputation/history of successful cases, (3) the support provided by the vendor, (4) local support (proximity of support).

CAUTION: Possible Wastes that can occur

The possible occurrence of defects is somewhat likely (during screening), Motion (handoff) and excess processing (be aware there is a possibly that this activity will drag on).

Phase 2: package evaluation and selection

CHECKLIST FOR TASK 2.2 & 2.3

Statements

Explanation

The purpose of this phase is

2.1: Create Proposals Evaluation Team

Sub activities: 2.2: Proposals analysis & Evaluation checklist

"Create a team from a number of departments/stakeholders that will have sole responsibility in making essential decisions…

…when you are doing a comprehensive evaluation it leads to making the right decisions based on justifications"

⬅ LEAN RECOMMENDATION FOR 2.1: Include team members from IT, business, finance etc. to make a joint consensus in evaluating the proposals (representatives from multiples departments that have their say). Identify the areas of the business and the applicable representatives to prose their opinions. Take in to consideration ethics, discriminatory laws etc.

⬅ LEAN RECOMMENDATION FOR 2.2 & 2.3: (1) Base the analysis on the checklist, word of caution/warning not be dragged/overly influenced by the finer detailing's or extra features which are not required. (2) During the evaluation the technical aspects should be reviewed followed by the cost aspect (good working practise). (3) It is likely that members will be drawn/attracted towards a brand - they should how ever base the judgement not on personal preference but through technical justifications

PHASE OUTPUT

xxx

⬅ LEAN TOOLS/TECHNIQUES TO UTILISE FOR 2.1: internal recruitment which will then go through a thorough screening of possible candidates (reviewing their history of experience/credentials)

⬅ LEAN TOOLS/TECHNIQUES TO UTILISE FOR 2.2 & 2.3: 5s (For checklist), the evaluation team should be consistent; the criteria must be uniform when reviewing the proposals (given by the vendors)

⚠ CAUTION: Possible Wastes that can occur

- Making mistake in selection and not utilising the right individual for the tasks
- Human error, during evaluation they can make mistakes, overlook, undertook, miss details etc.

Wastes to look out for: [Task 2.1] *1 & 4.* [Task 2.2. & 2.3] *1, 3*

XXXX

Add any additional information here what ever you feel is necessary

XXX

XXX

XXX

XXX

XXX

XXXXXXXXXXXXXX

XXXXXXXXXXXXXX

XXXXXXXXXXXXXX

2.4: Packages Benchmarking

Sub activity: 2.5: Proposals analysis & Evaluation checklist

"This activity can only be performed after successfully completing the previous tasks – this is an outcome of tasks 2.1-2.3."

LEAN RECOMMENDATION: (1) in order to avoid the occurrence of mistakes, users are advised to utilise the benchmarking and trade off curves correctly and to the most applicable level, and base their judgments on rational facts. (2) you have not committed to the selection of package therefore thy still have time to thoroughly examine the options that are available and contact directly the vendors regarding any concerns or additional add-ons or customisability of certain features (ensure this is done based on the correct policy)

LEAN TOOLS/TECHNIQUES TO UTILISE FOR 2.1: (1) Benchmarking, (2) decisions made through trade off curves, criteria: time, against functionalities, cost and qualification of vendor

CAUTION: Possible Wastes that can occur

During this task there likelihood of making mistakes and taking too much time.

Wastes to look out for: 1 & 3

Appendix H: Requirements document from public tender process

Business Analysis Document

Project Name:

Project of Developing and Monitoring of XYZ Projects

Document Details	
Document Name:	Report for functional requirements
Reference Number:	001
Name Of Processes:	Tender Procedures
Process Name:	Public Tender
Process Type:	Main
Version Number:	2.0
Version Date:	26th September, 2013

Documented by:

Change Log

Author	Date	Version	Revisers	Change Ref.
	19th Sep, 2013	1.0		
	26th Sep, 2013	2.0		English Translation

Approval of Stakeholders

Name	Job Role	Department	Date	Signature

1. Introduction

1.1 Purpose of the document

The purpose of this document is to compile and document all the required procedure to develop the process of the 'offering public tender', this document give brief description of the steps involved in the public tender process.

This document contain three main sections;

Section 1: Process Flow, it is the detailed diagram for the steps been involved in the process as describe in Use cases. This diagram drawn using the **Business Process Modeling Notation (BPMN)**

Section 2: A description and documented in writing to some of the requirements, conditions and limitations associated with these procedures.

Section 3: Mock up screens (conceptual drawings) for the forms or screens related to this process.

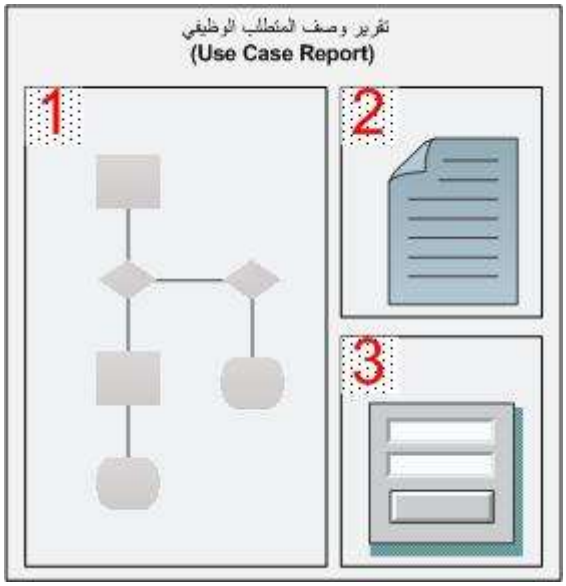
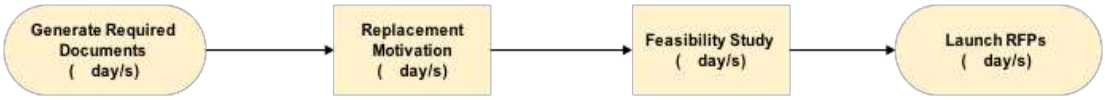


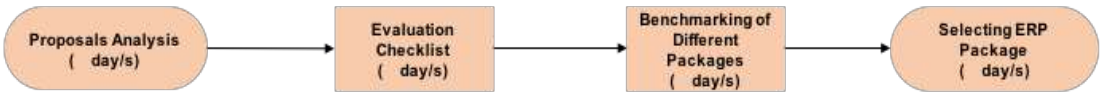
Figure H1: Document Format

Appendix I: ERP Flow – VSM Workshop

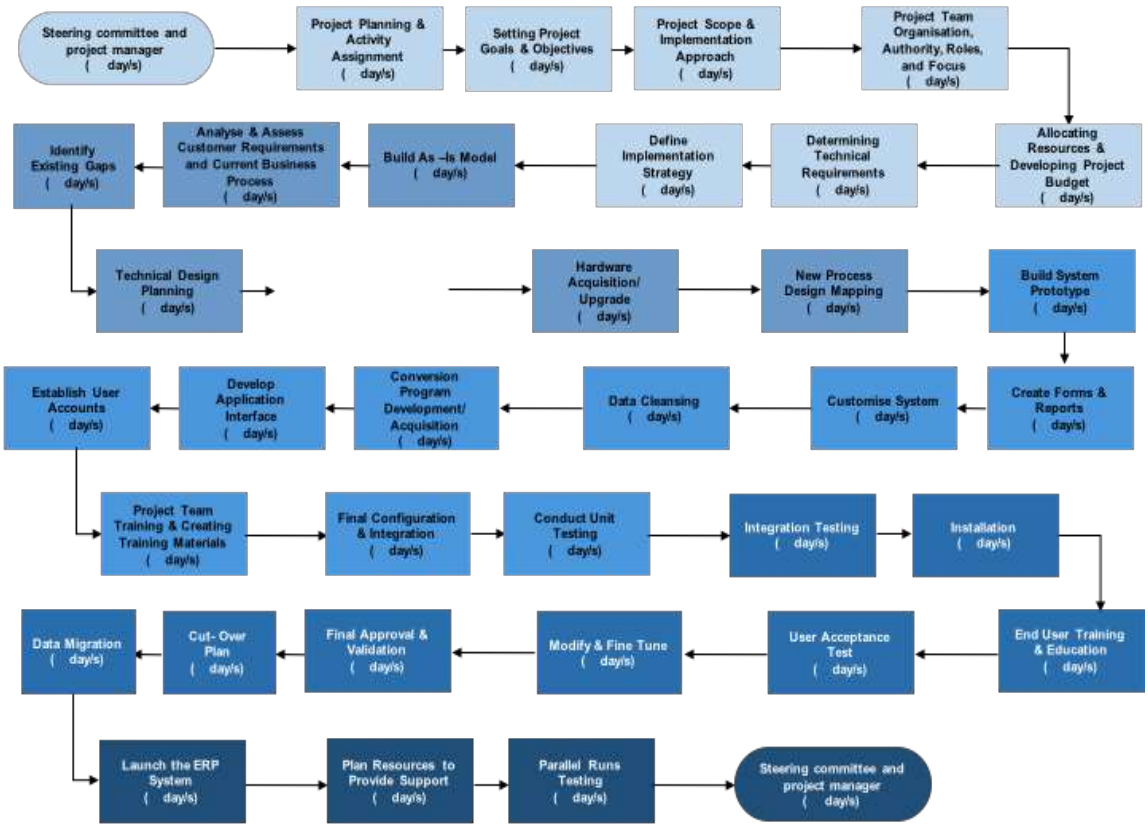
Phase 1: Needs Identification



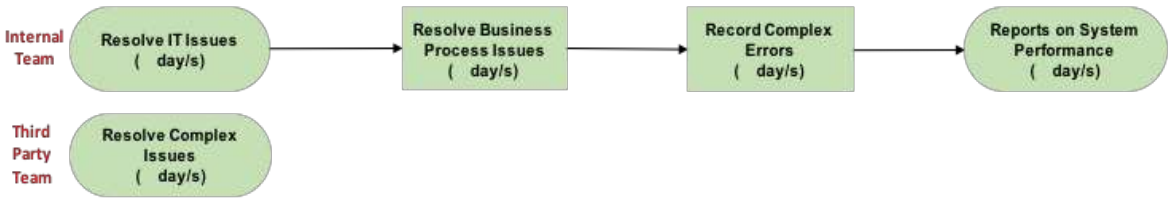
Phase 2: Package Evaluation & Selection



Phase 3: Implementation



Phase 4: Post Go Live Support



Phase 5: Maintenance